



(12) **United States Patent**
Pagel et al.

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(54) **METHODS AND APPARATUS FOR APPLICATION OF NESTED ZERO WASTE EAR TO TRAVELING WEB AND FORMATION OF ARTICLES USING A DUAL CUT SLIP UNIT**

(58) **Field of Classification Search**
CPC B32B 38/04; B32B 38/06; B32B 38/10; A61F 13/15723; A61F 13/15756; A61F 13/15804
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See application file for complete search history.

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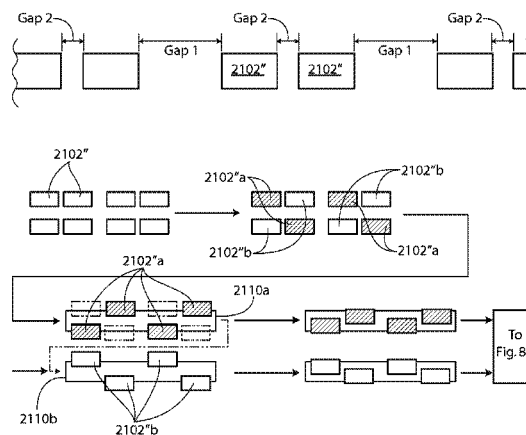
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(57) **ABSTRACT**

The present invention provides a method of providing a disposable product with zero waste ear formation and attaching the ears to a running chassis web. A cut/slip operation is performed on an incoming web carried by a transfer drum, and the cut/slip pieces are further divided and next separated by a second transfer drum and bonded to incoming webs.

6 Claims, 50 Drawing Sheets



Related U.S. Application Data

which is a continuation-in-part of application No. 12/151,667, filed on May 8, 2008, now Pat. No. 8,106,972, application No. 13/650,625, which is a continuation-in-part of application No. 12/806,891, filed on Aug. 24, 2010, now Pat. No. 8,293,056, which is a continuation-in-part of application No. 11/436,274, filed on May 18, 2006, now Pat. No. 7,780,052.

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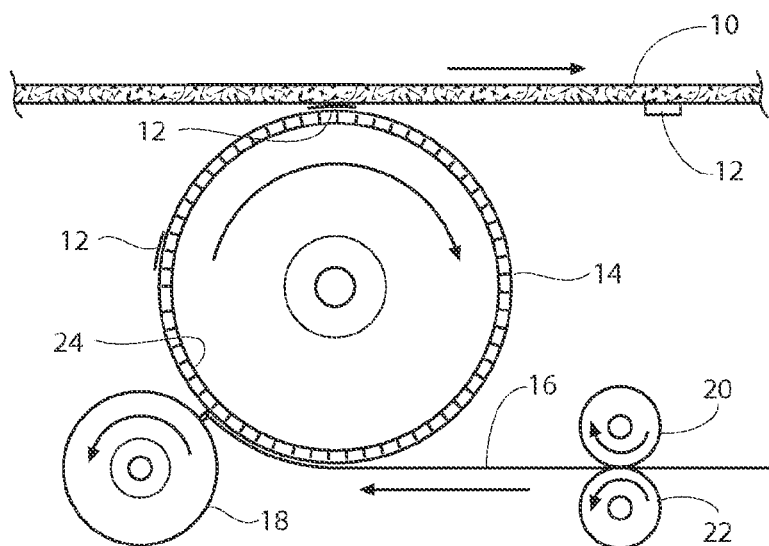


Fig. 1
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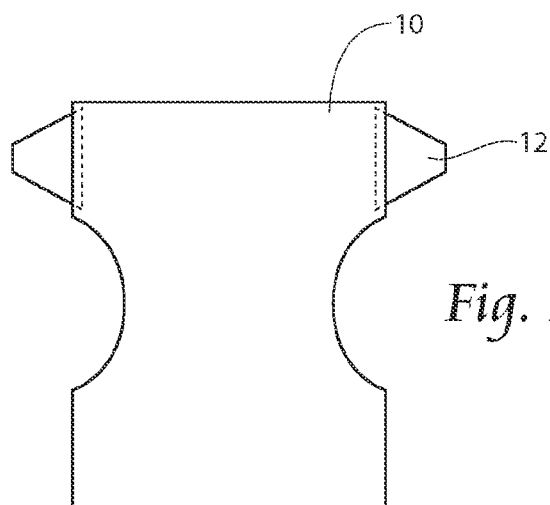


Fig. 2

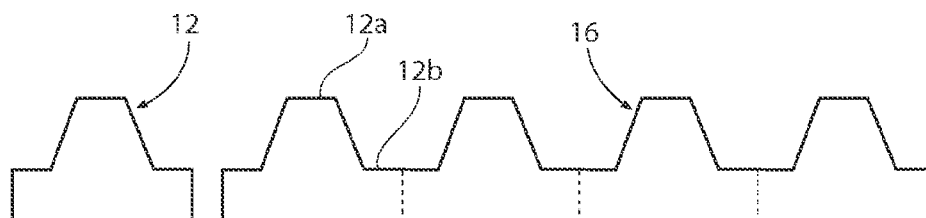
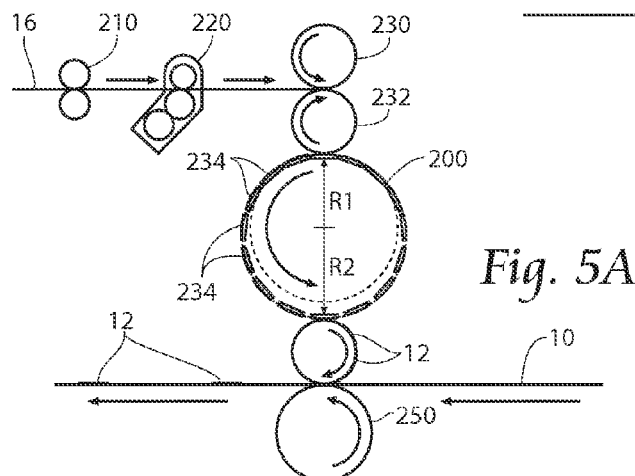
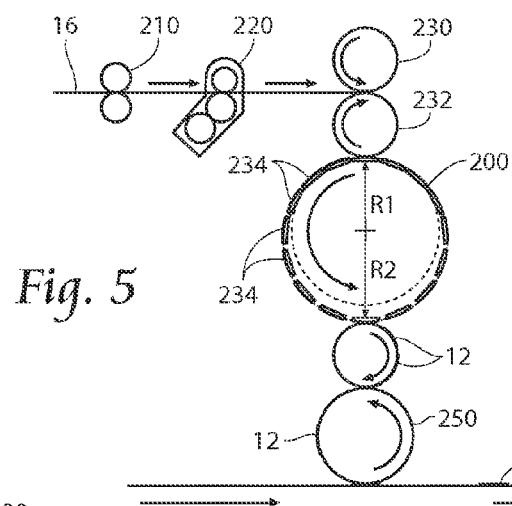
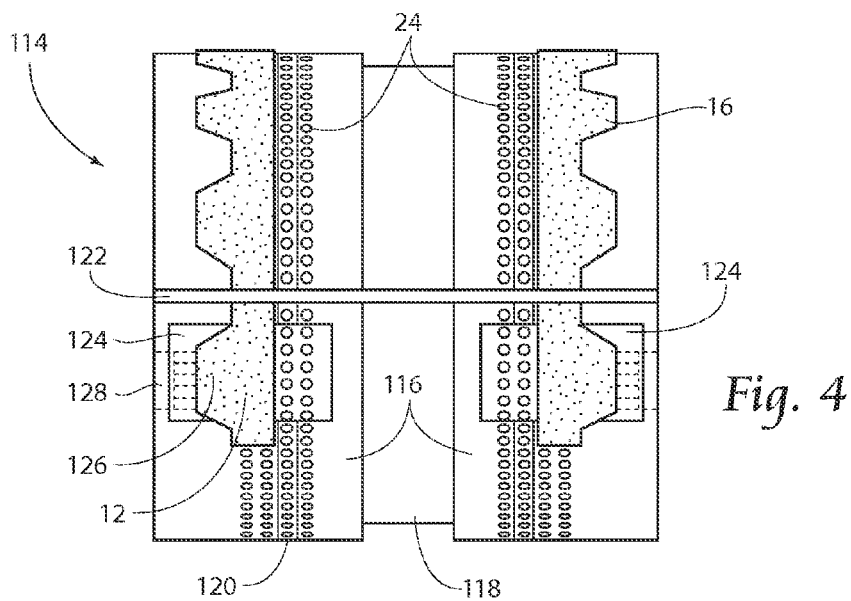


Fig. 3



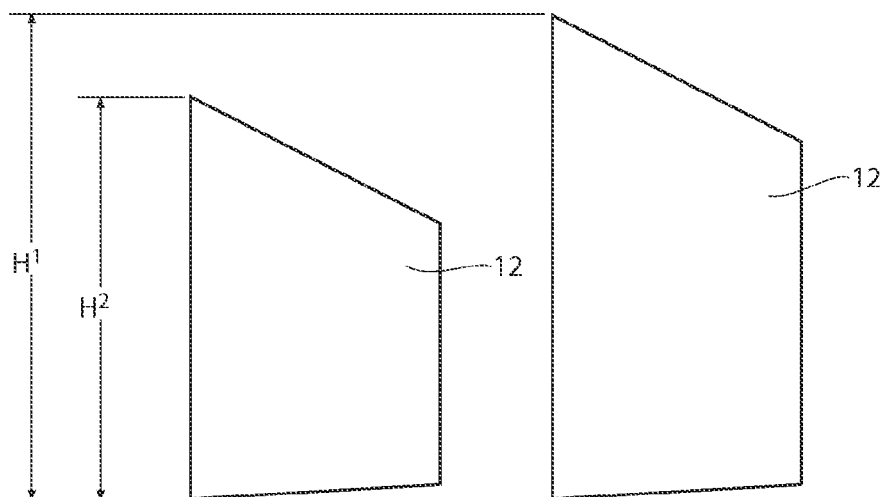


Fig. 6

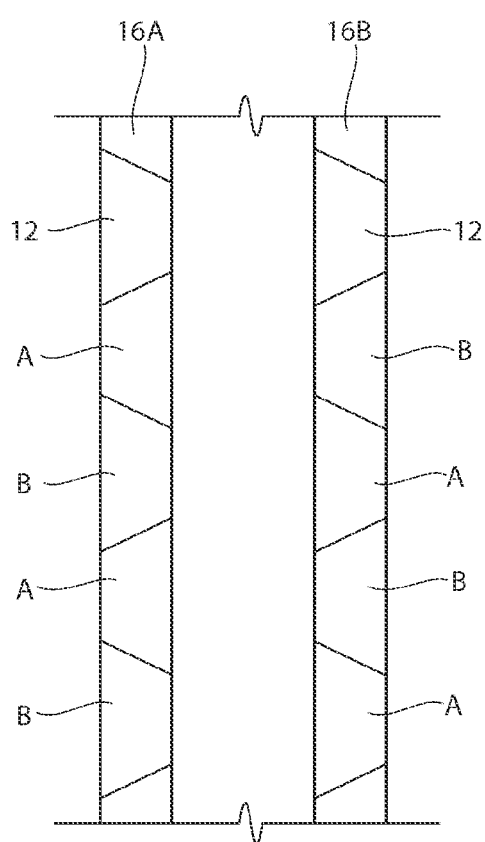


Fig. 7A

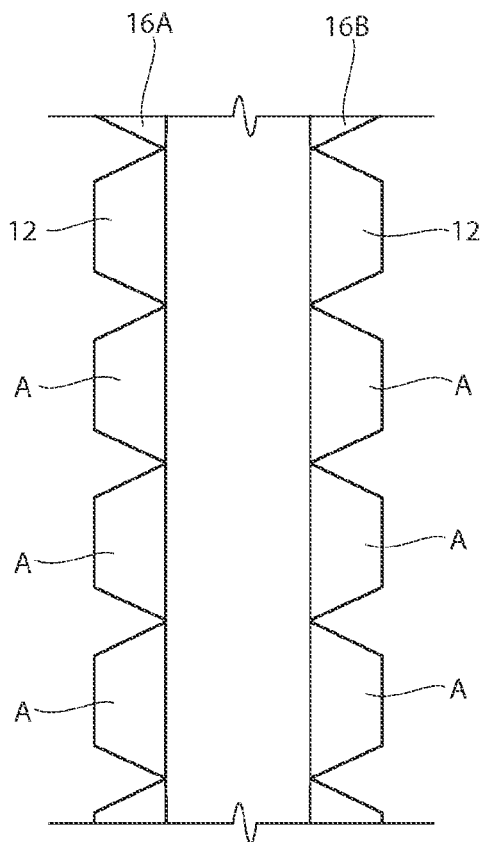


Fig. 7B

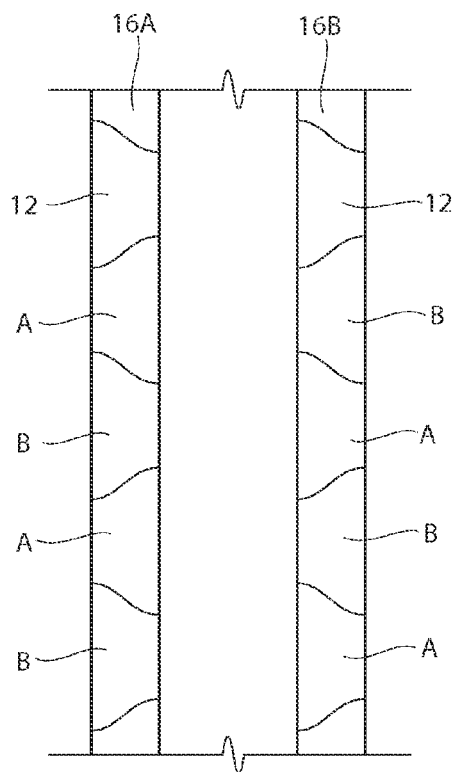


Fig. 7C

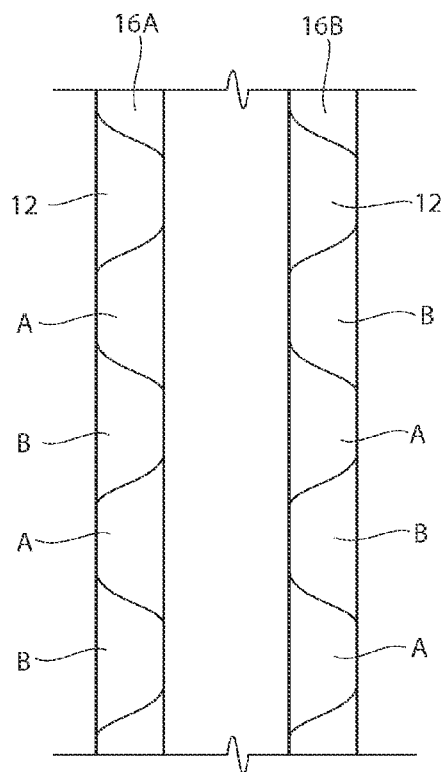


Fig. 7D

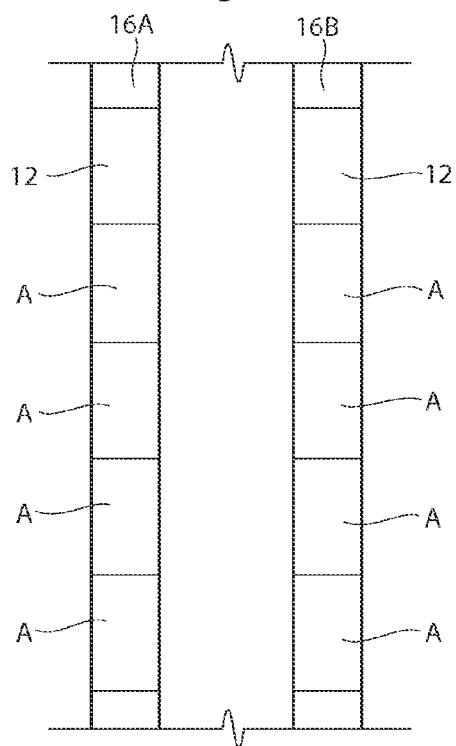


Fig. 7E

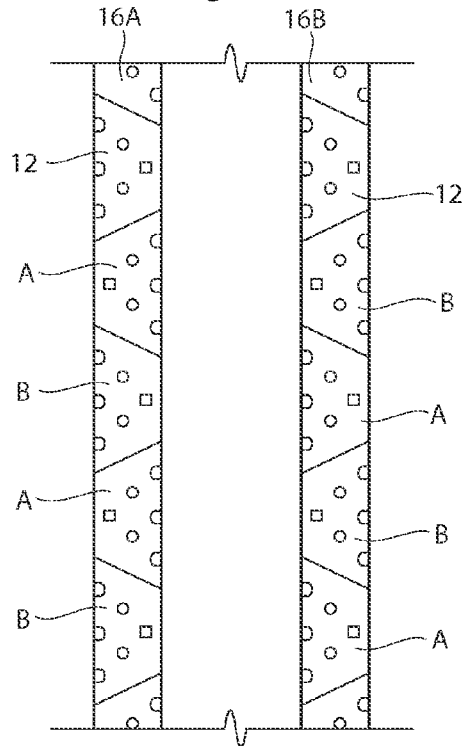
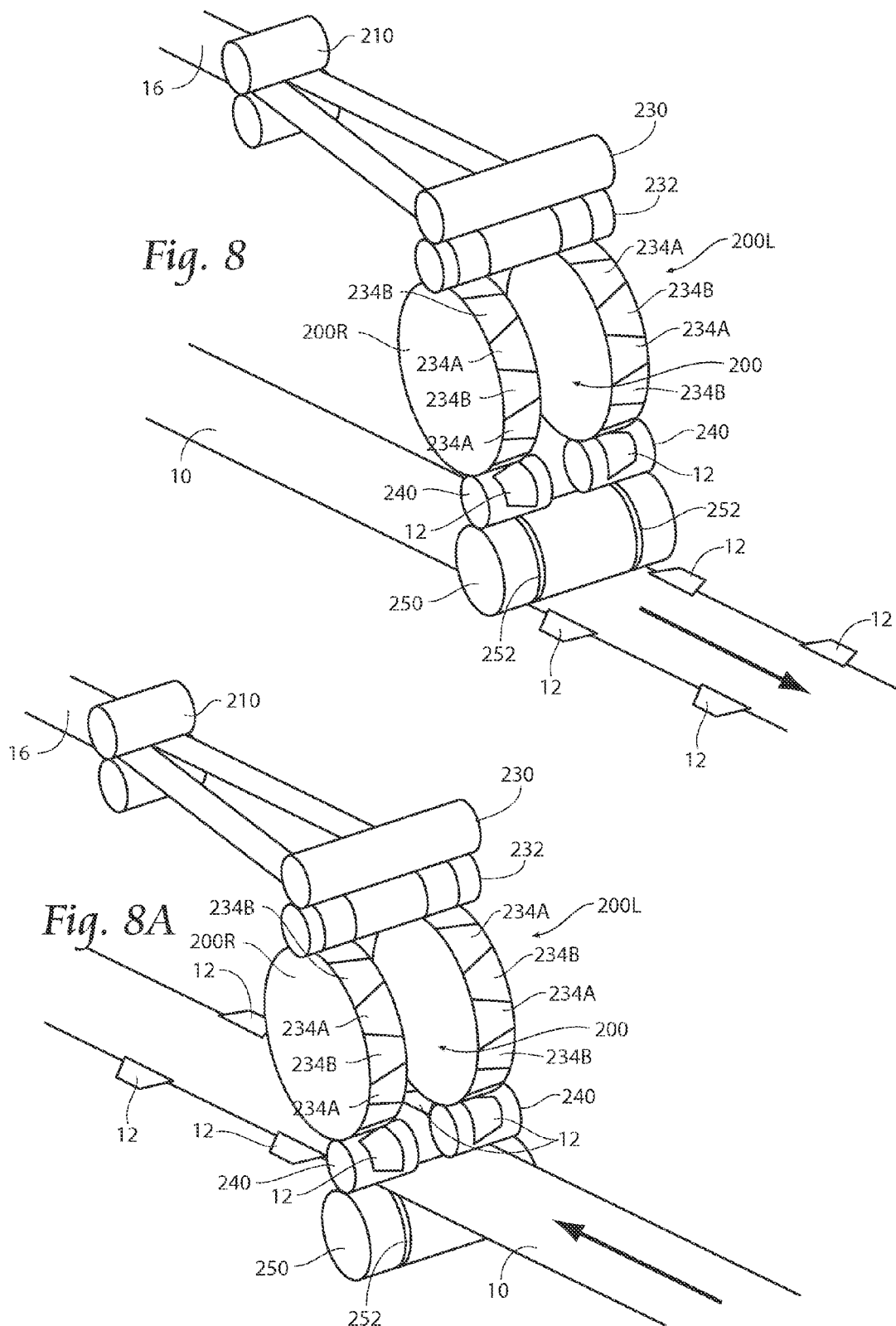


Fig. 7F



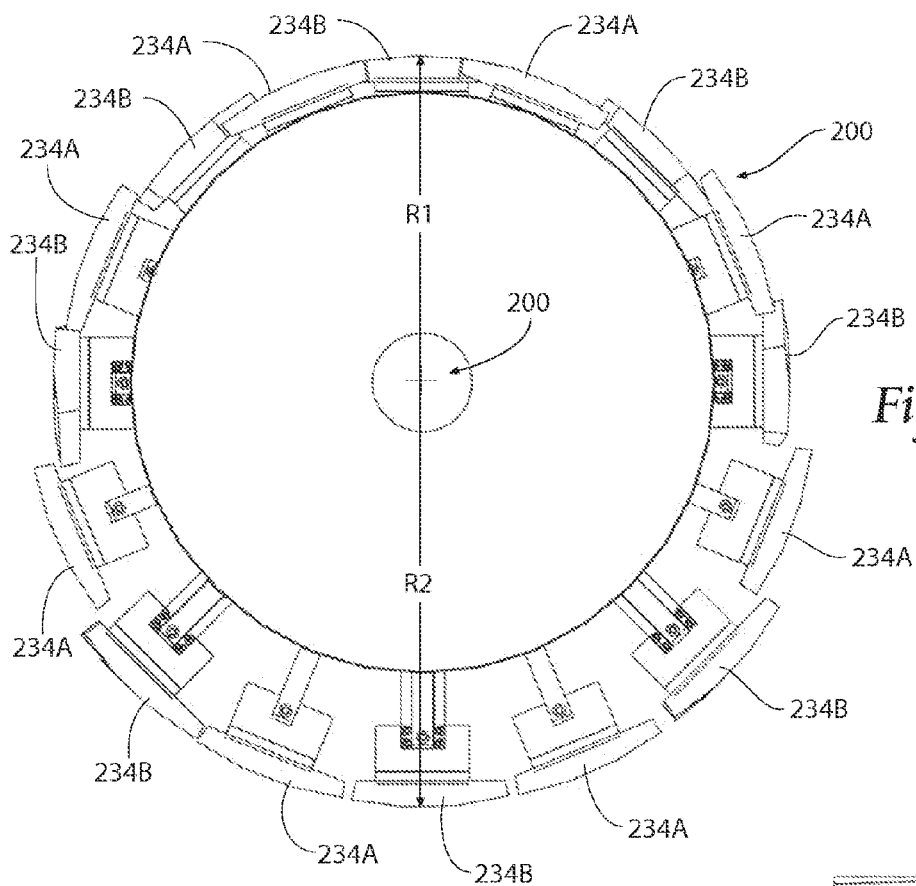


Fig. 9

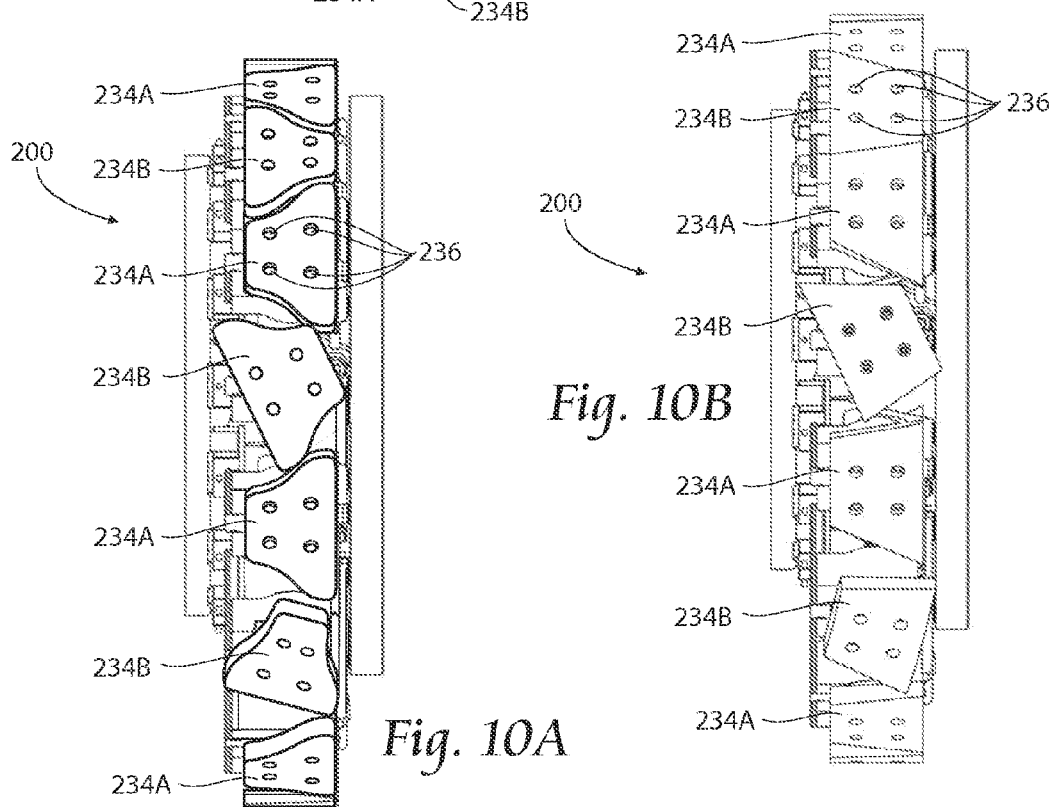
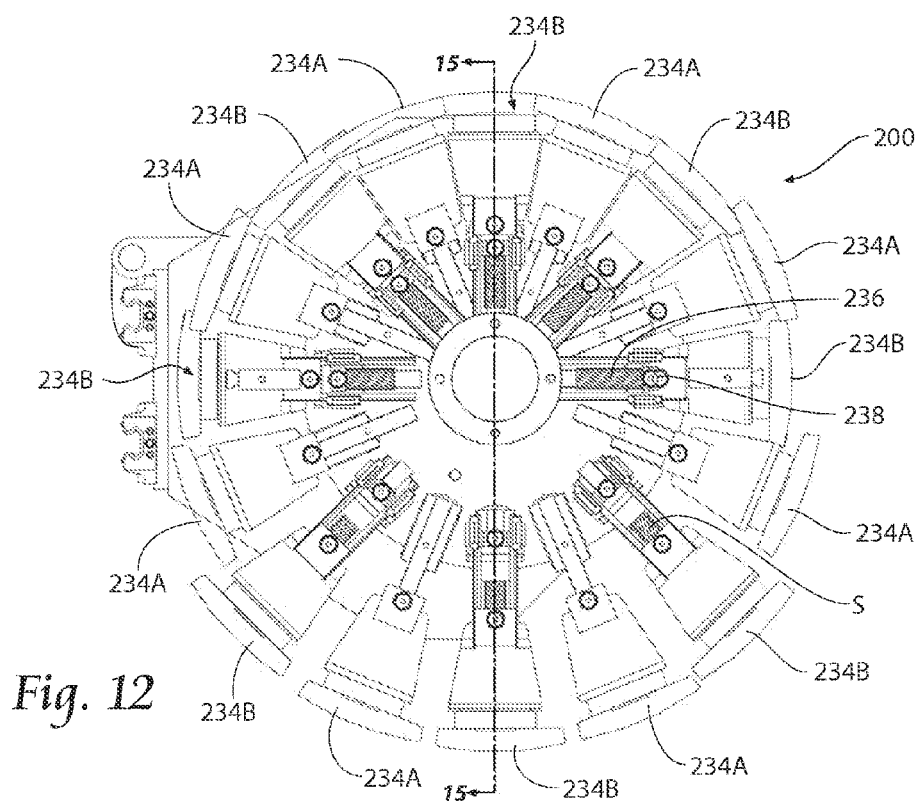
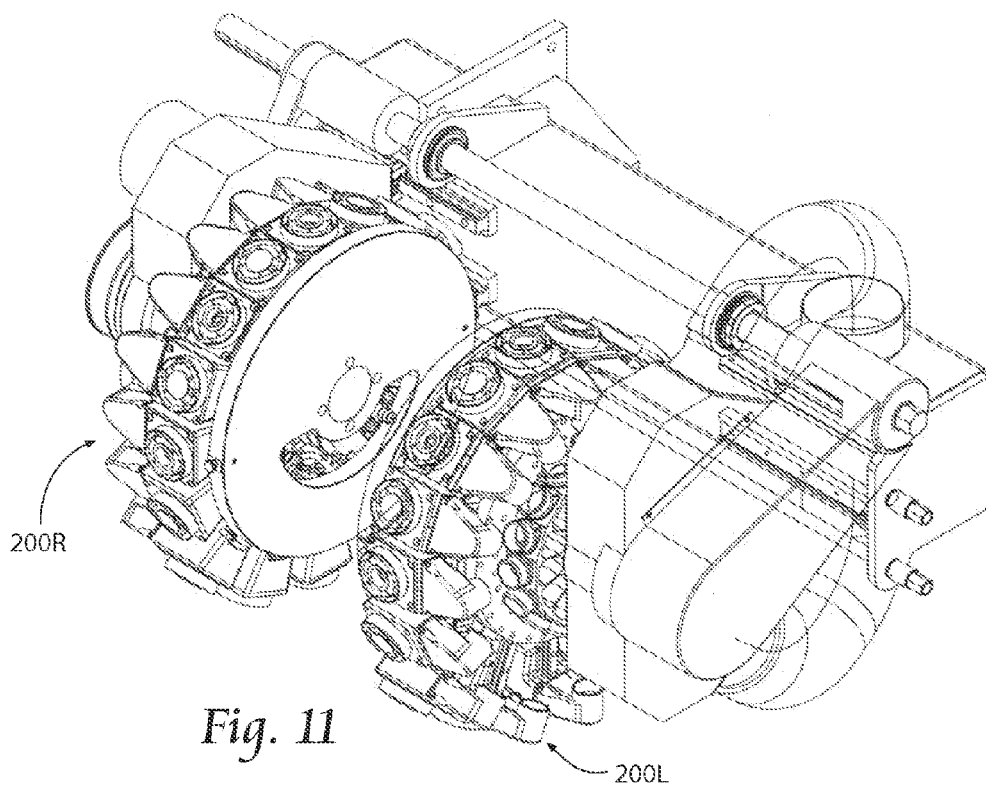
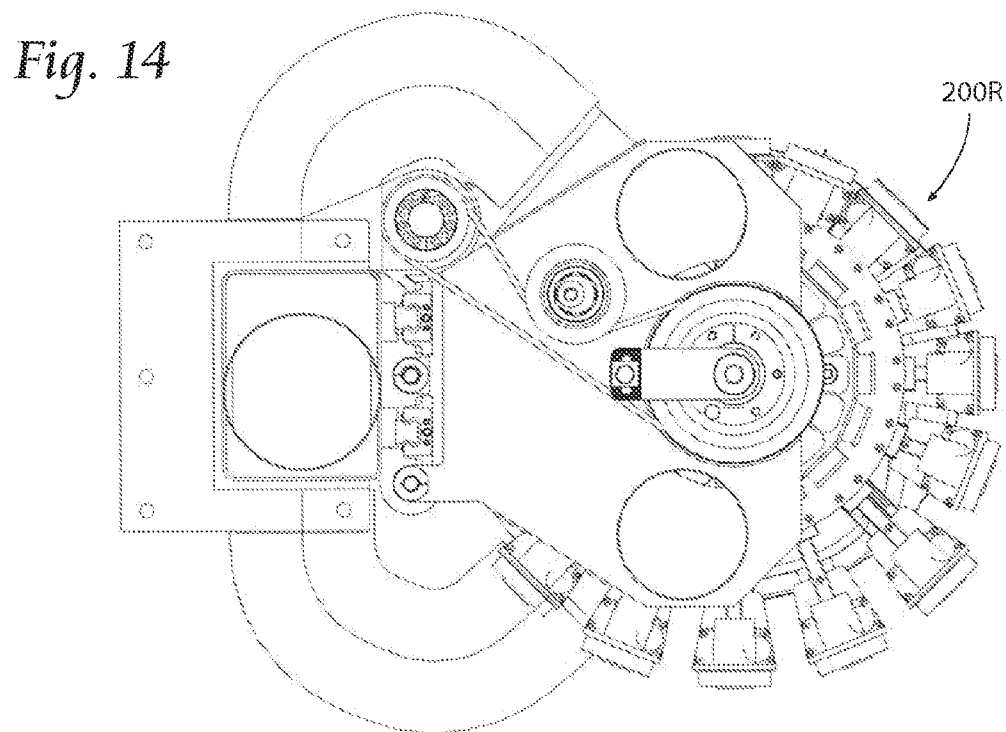
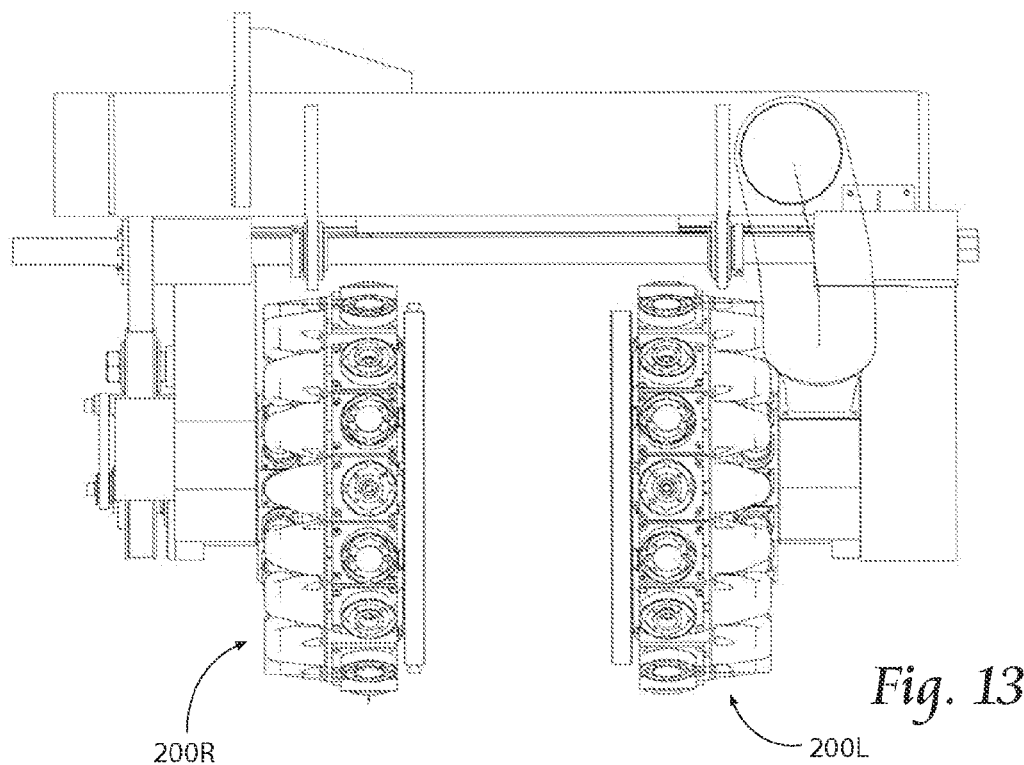


Fig. 10B

Fig. 10A





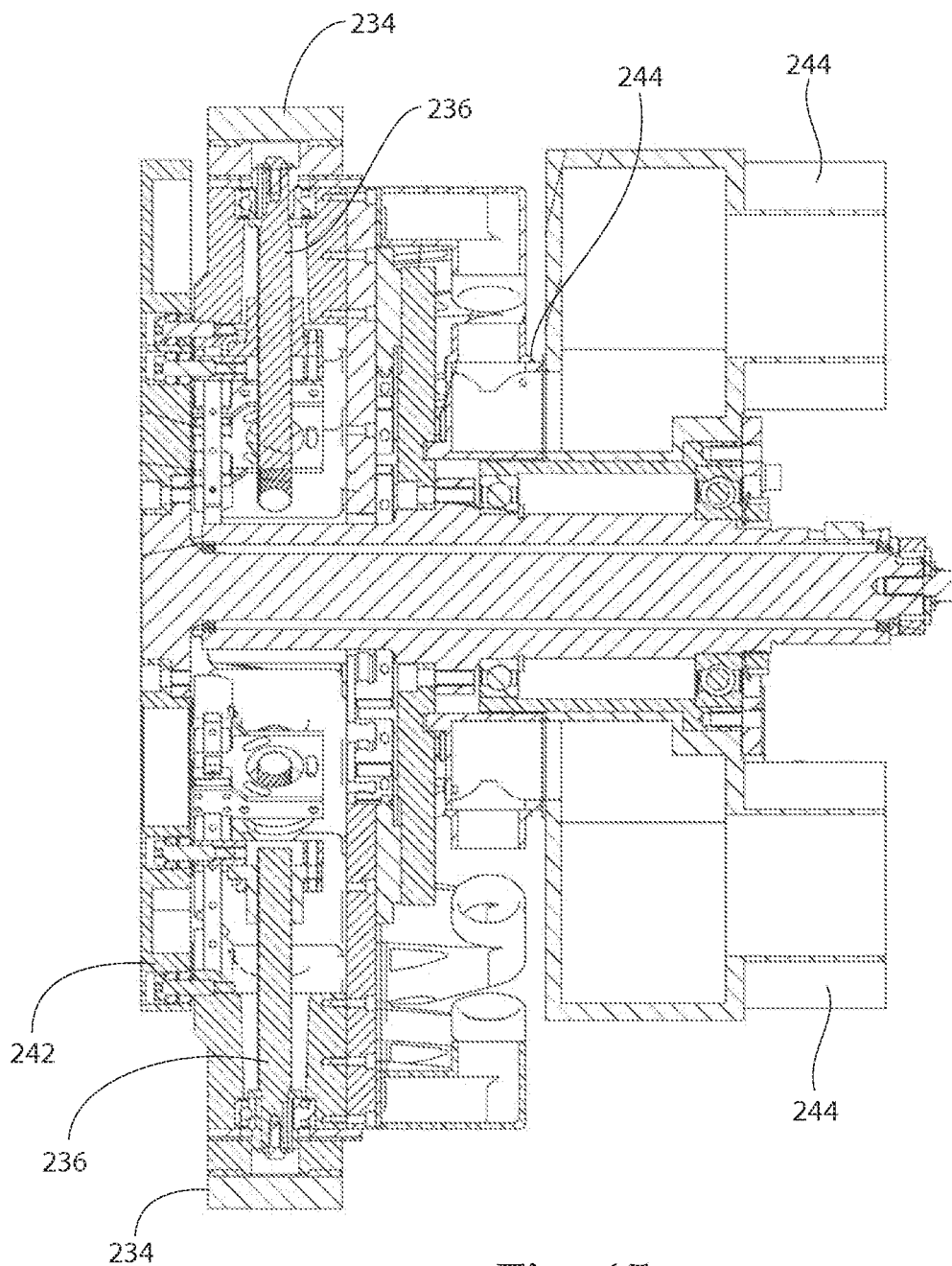


Fig. 15

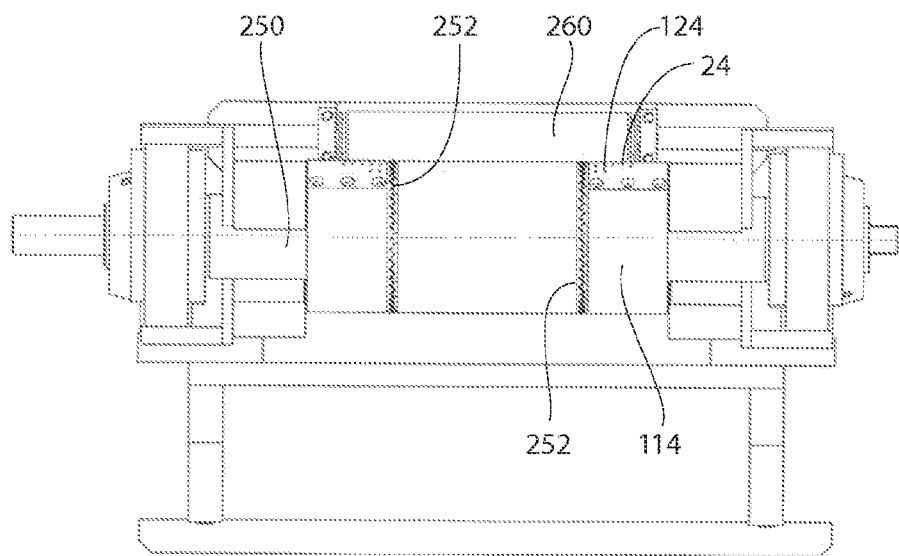


Fig. 16

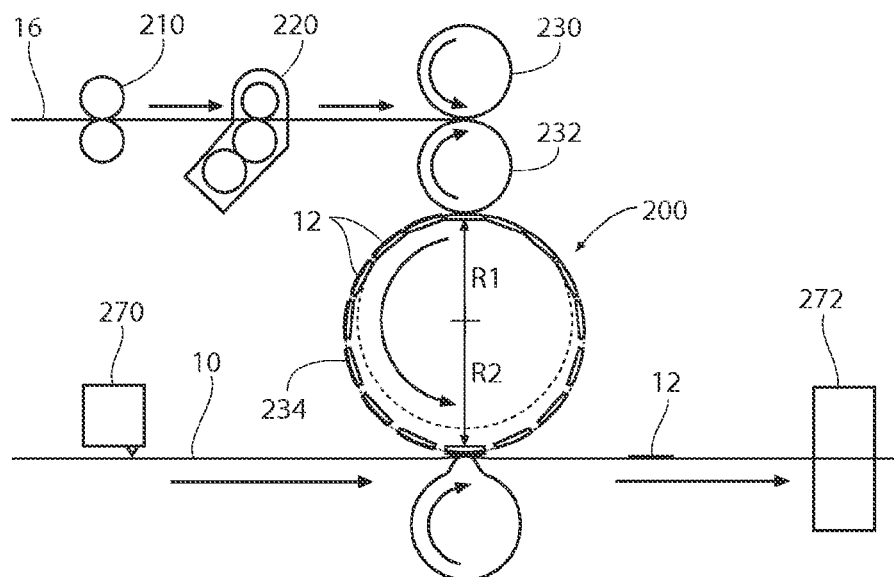


Fig. 17

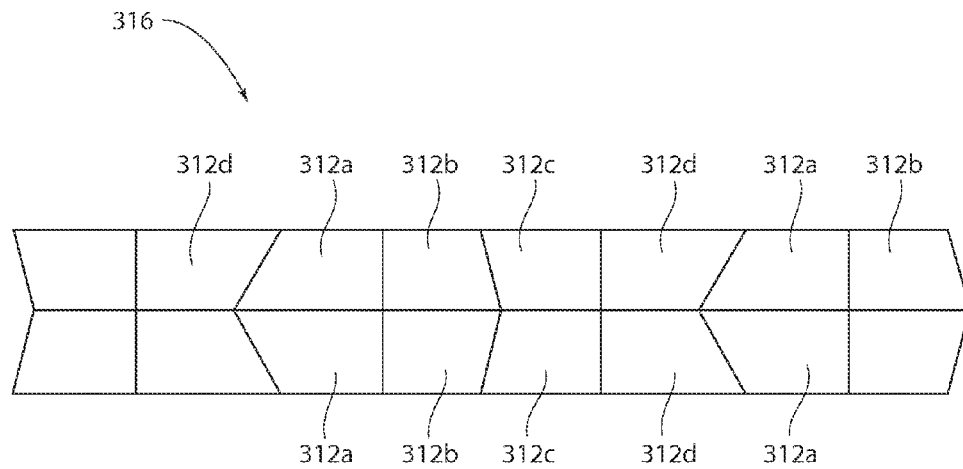


Fig. 18

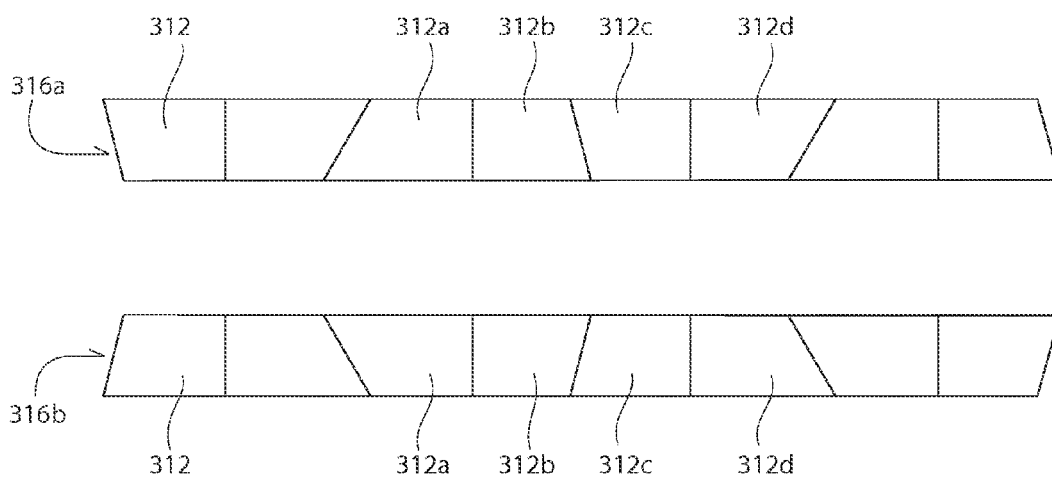
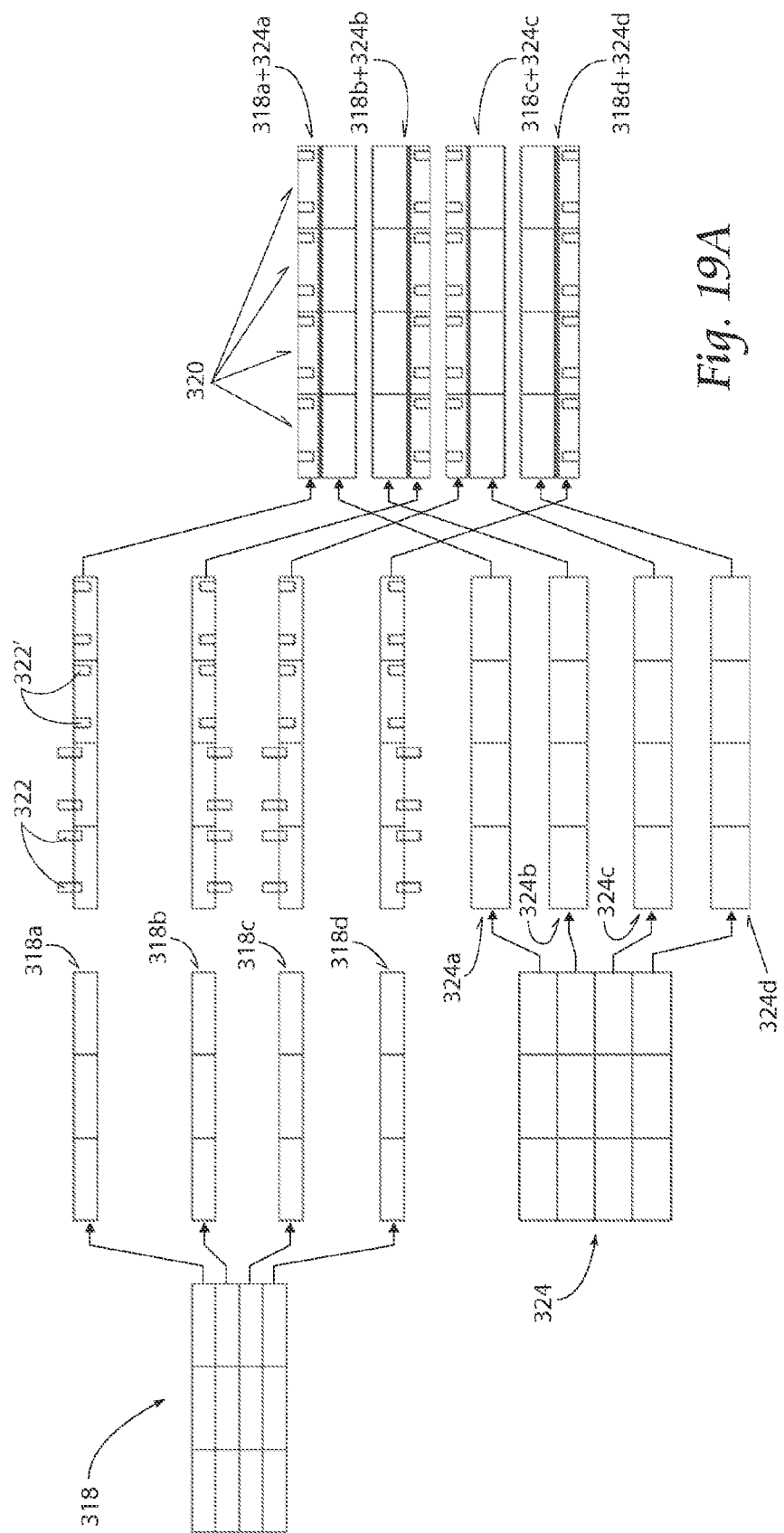


Fig. 19



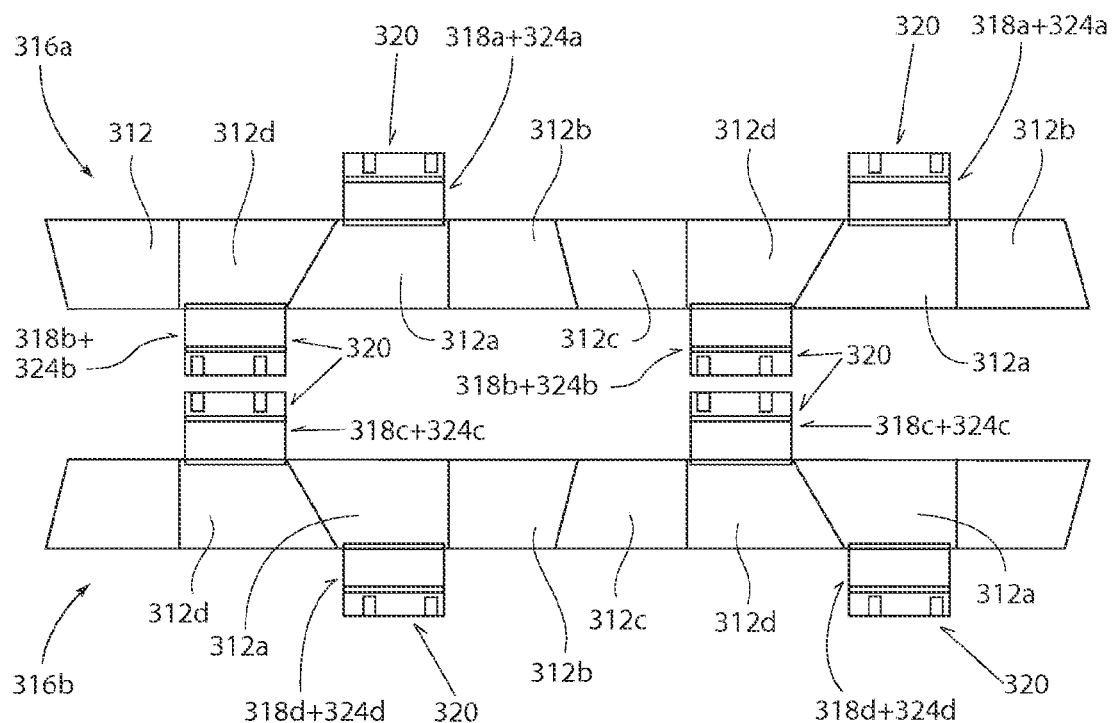


Fig. 20

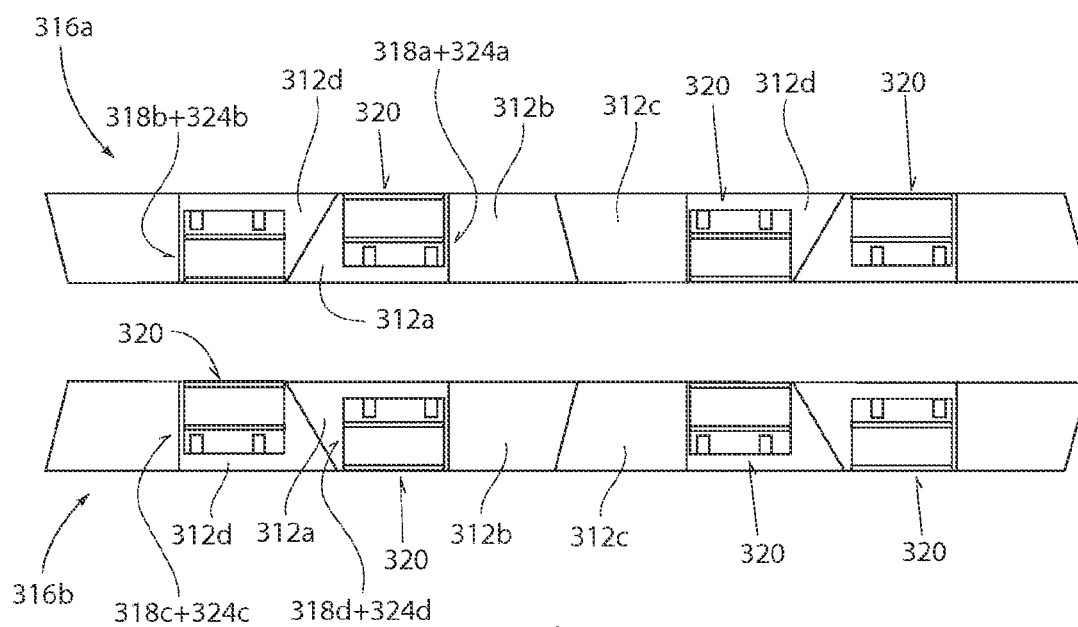


Fig. 21

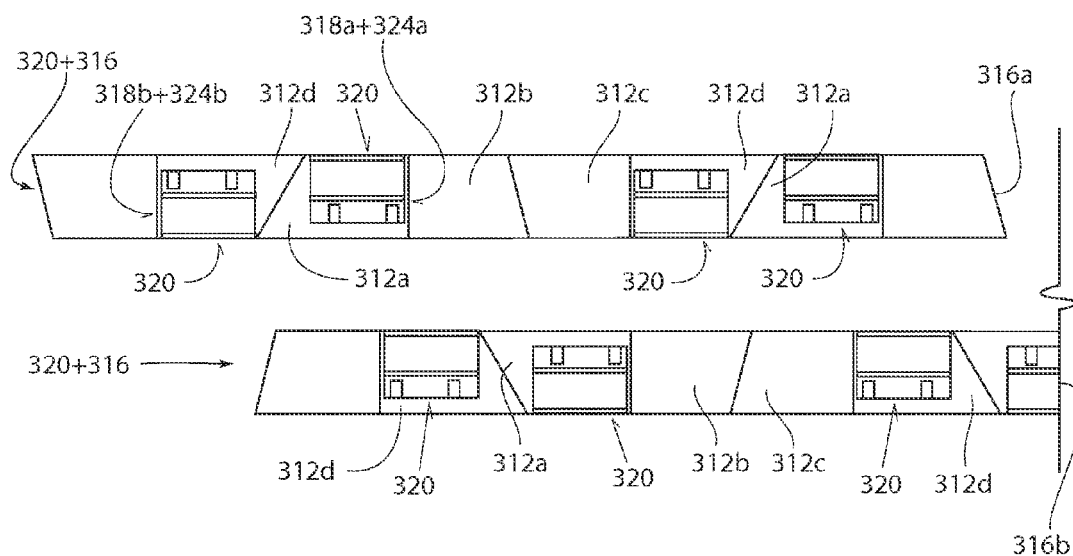


Fig. 22

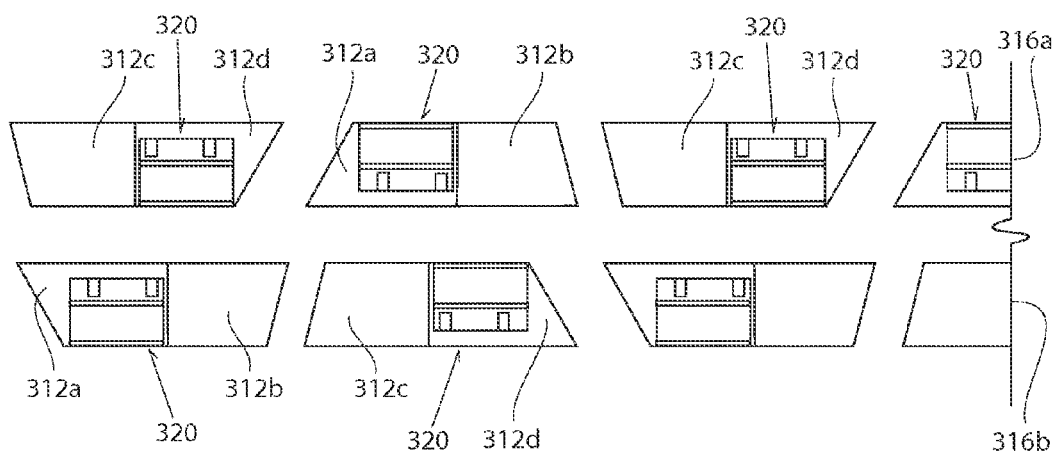
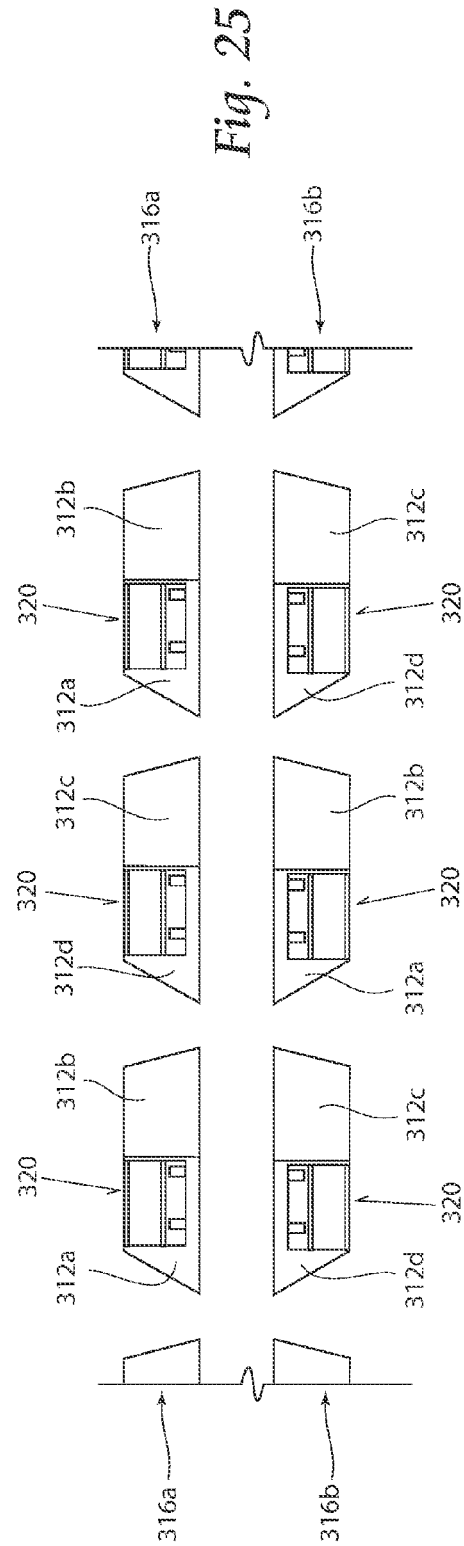
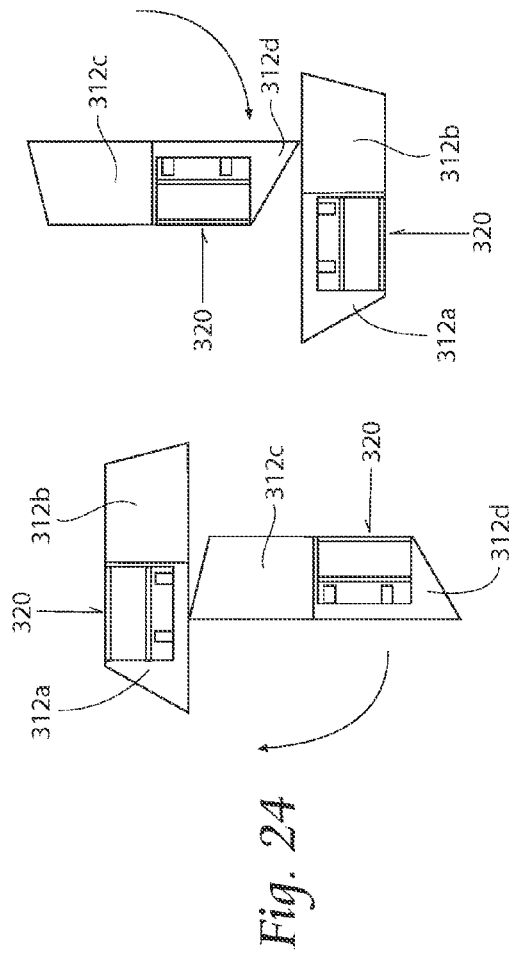


Fig. 23



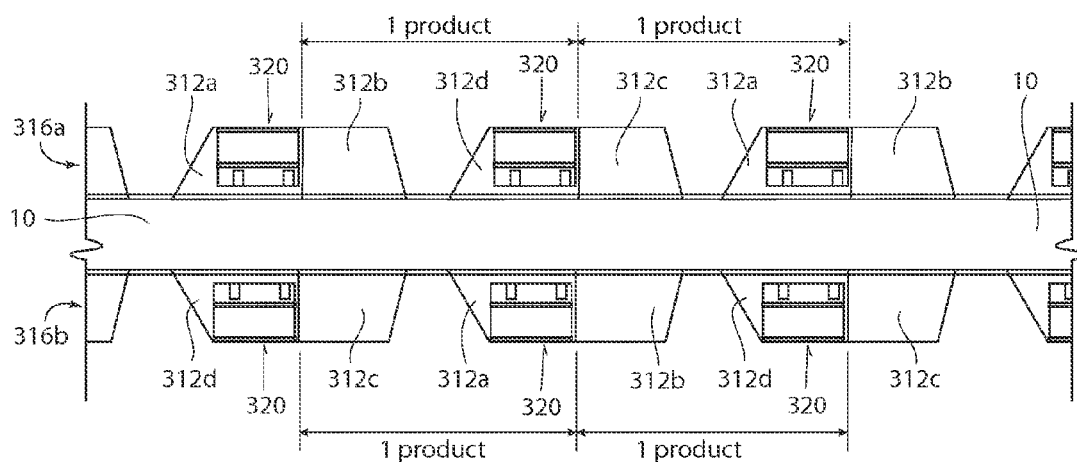


Fig. 26

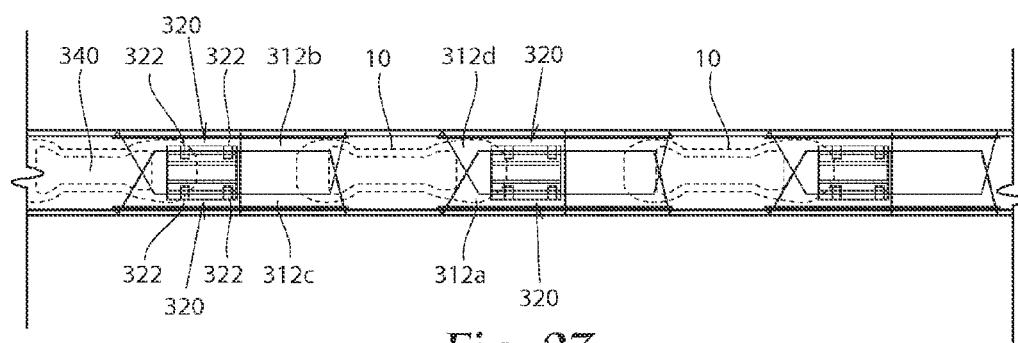


Fig. 27

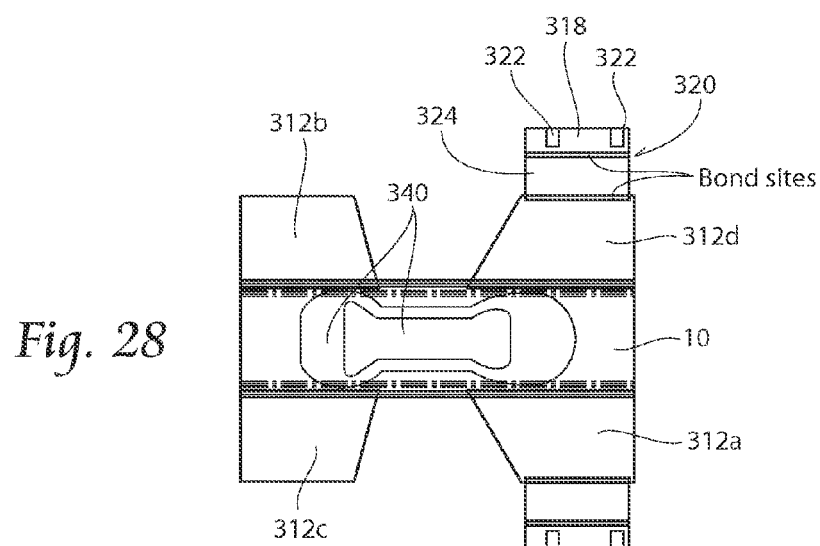


Fig. 28

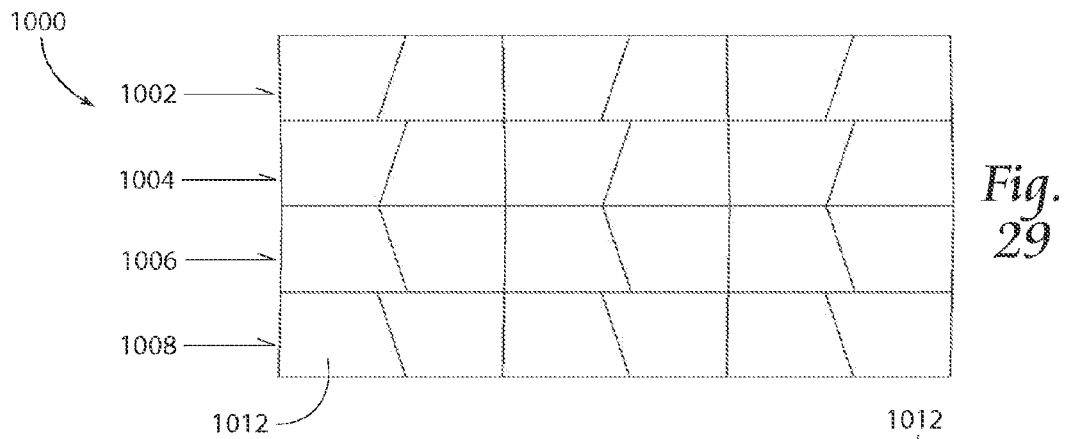


Fig. 30

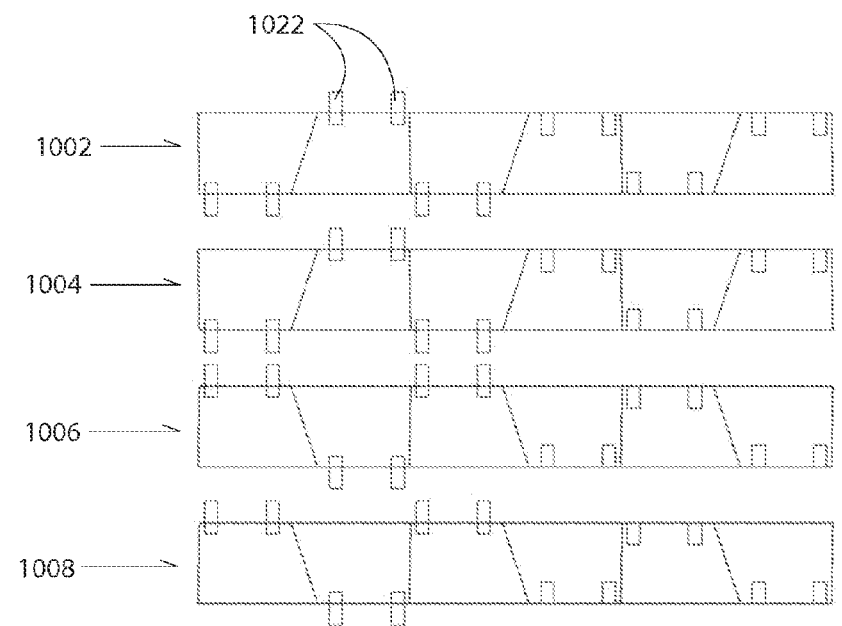
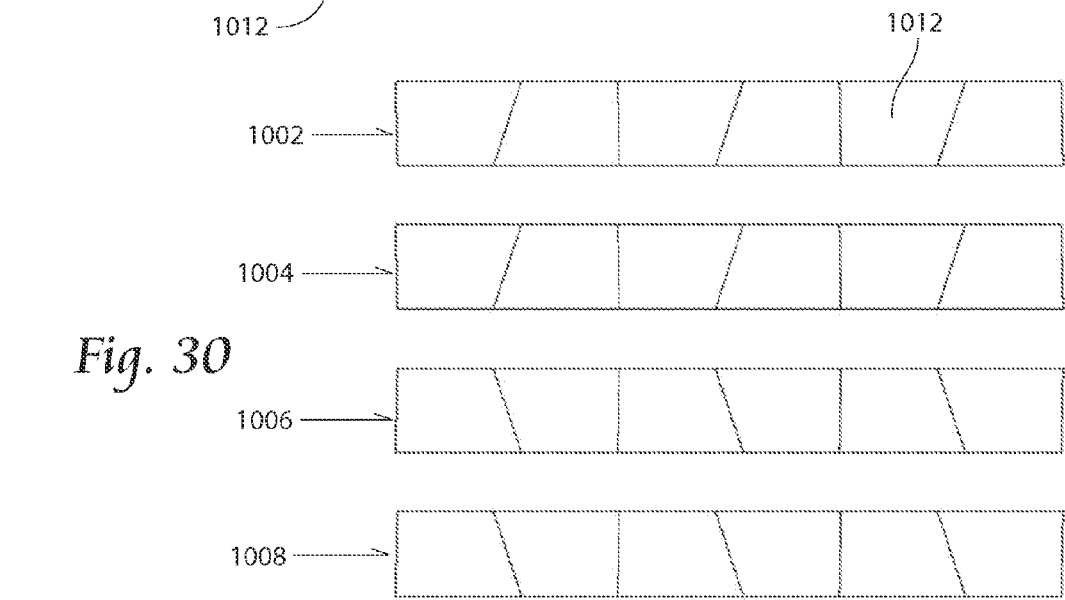
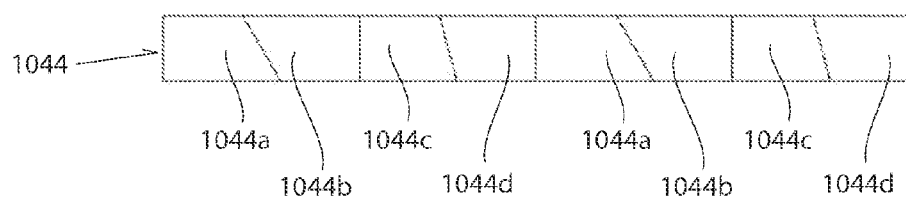
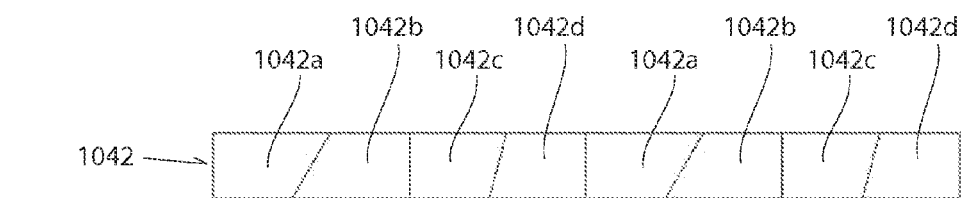
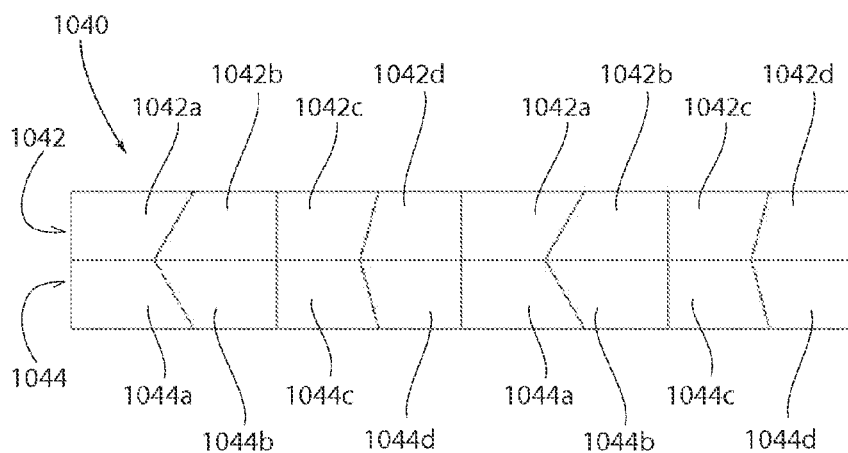
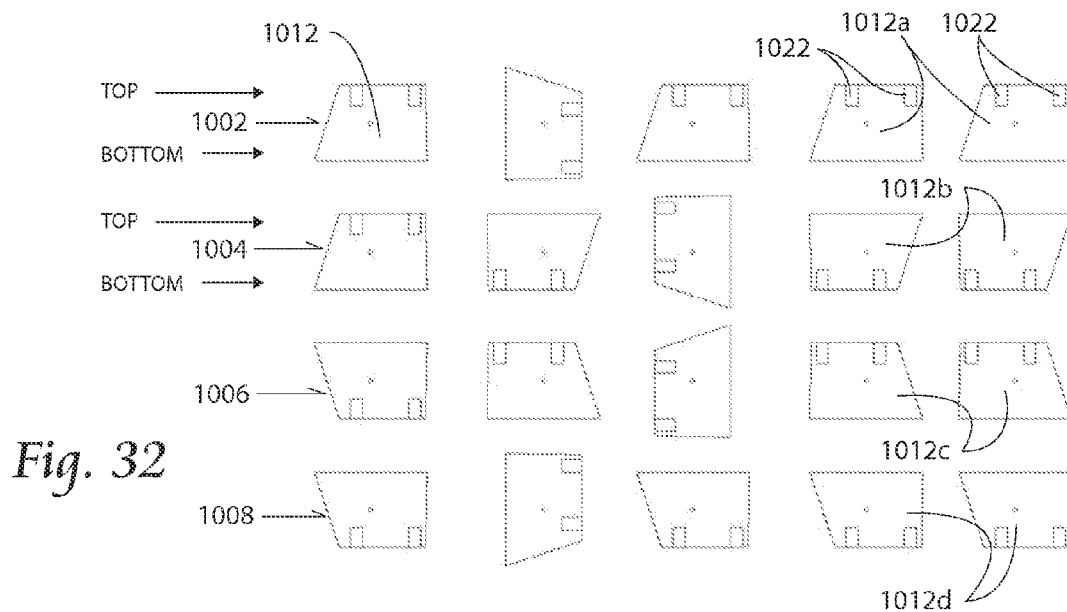
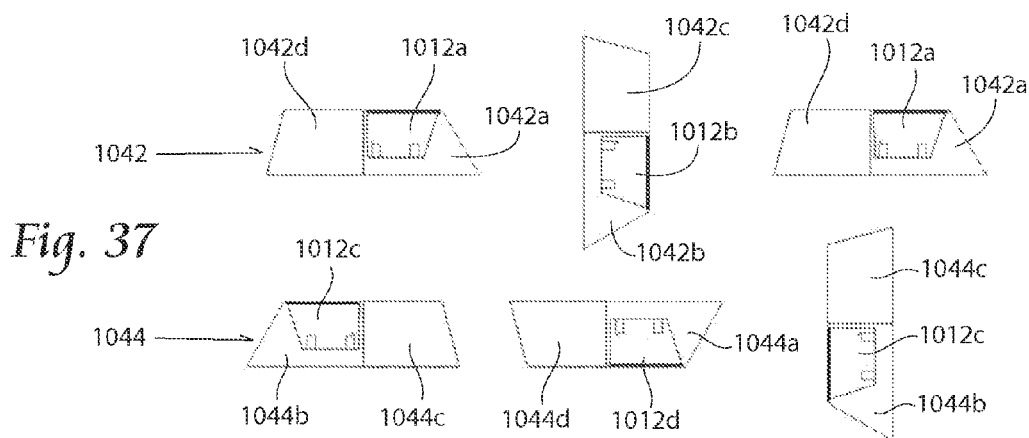
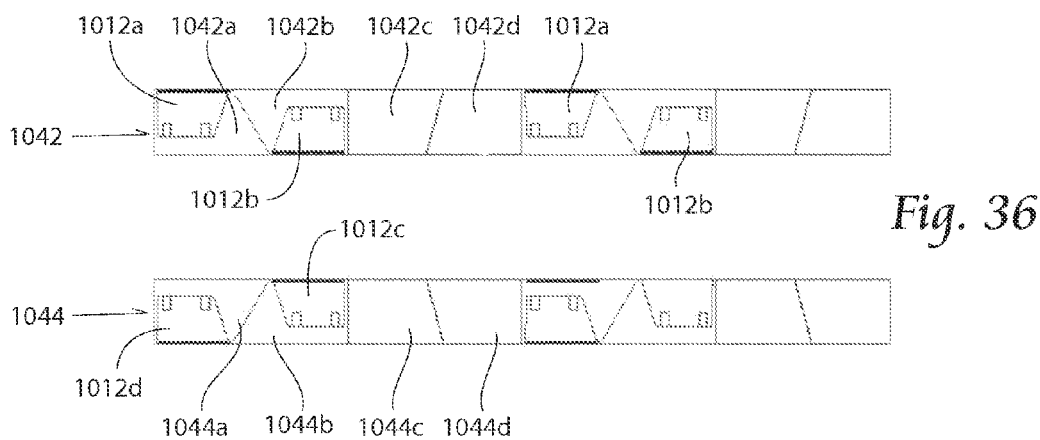
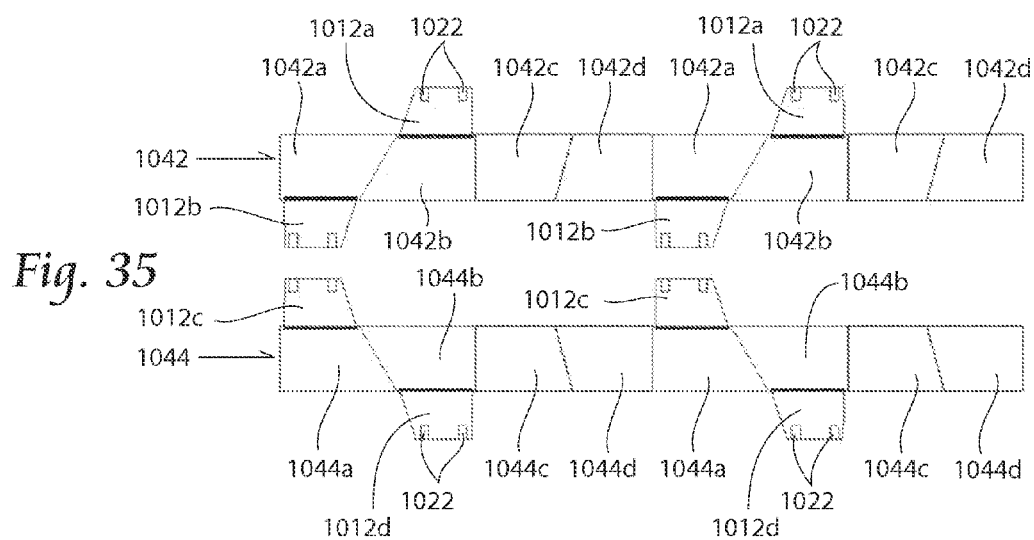


Fig. 31





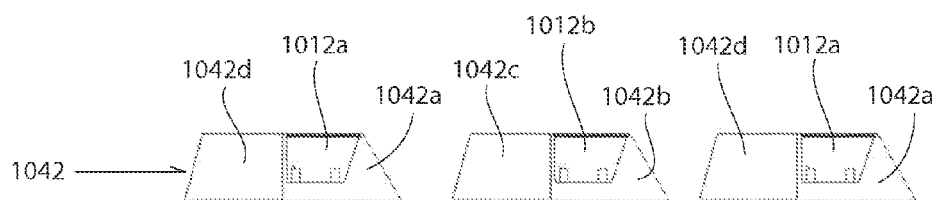


Fig. 38

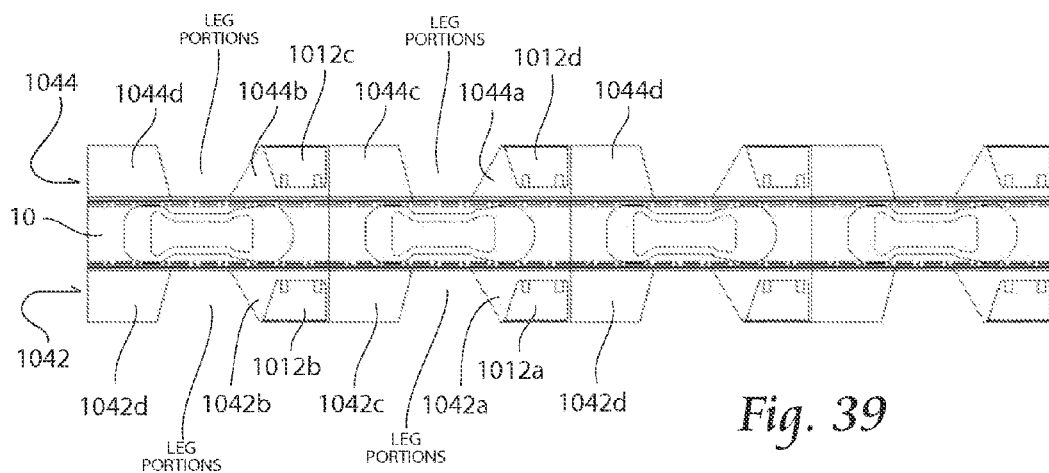
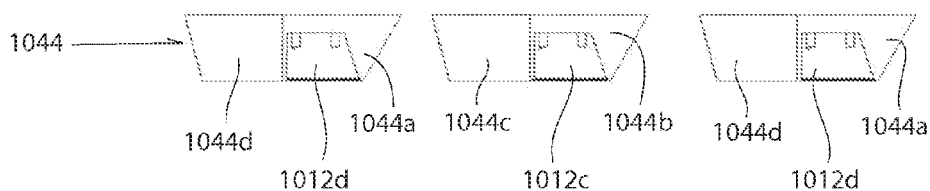


Fig. 39

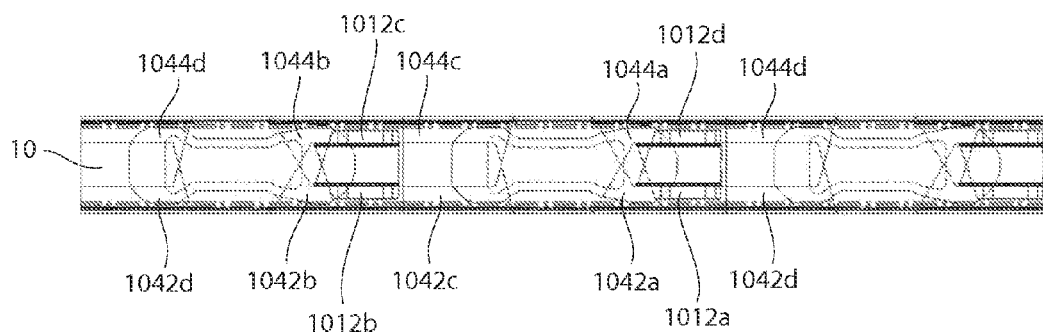


Fig. 40

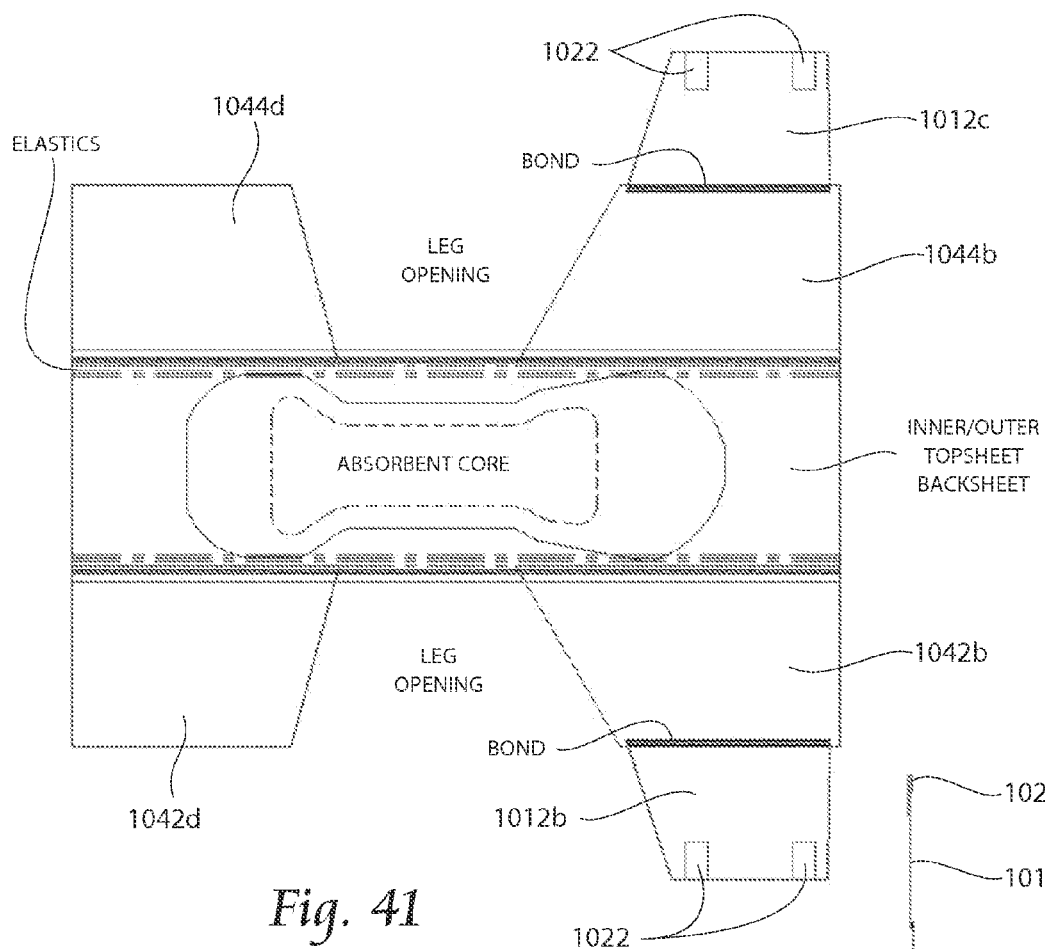


Fig. 41

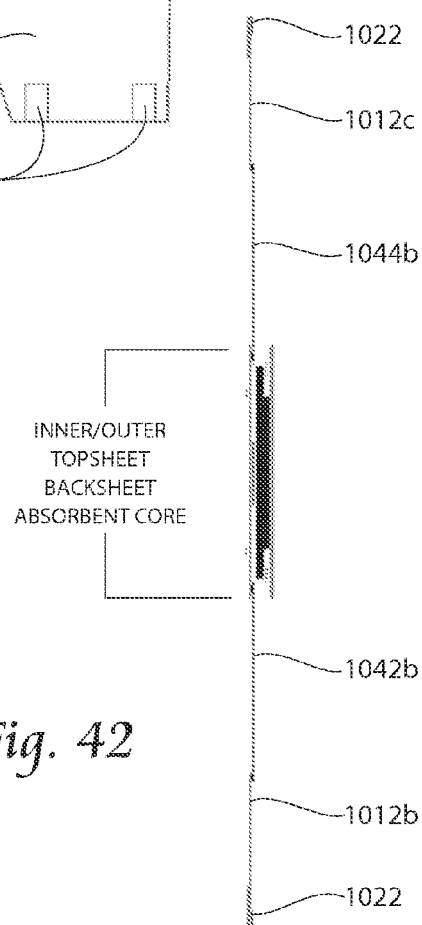


Fig. 42

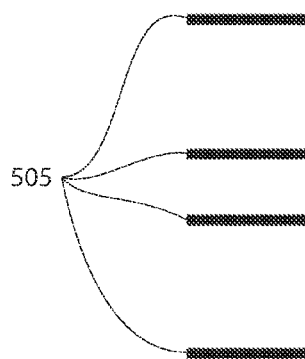
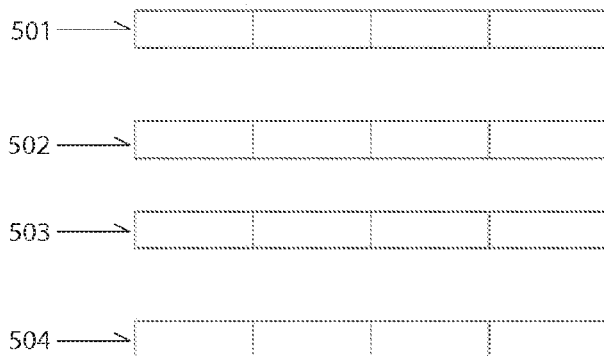
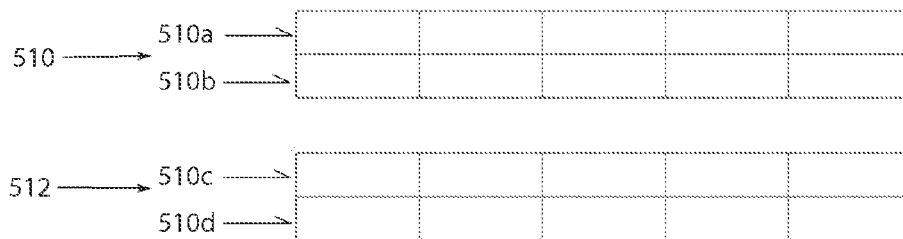
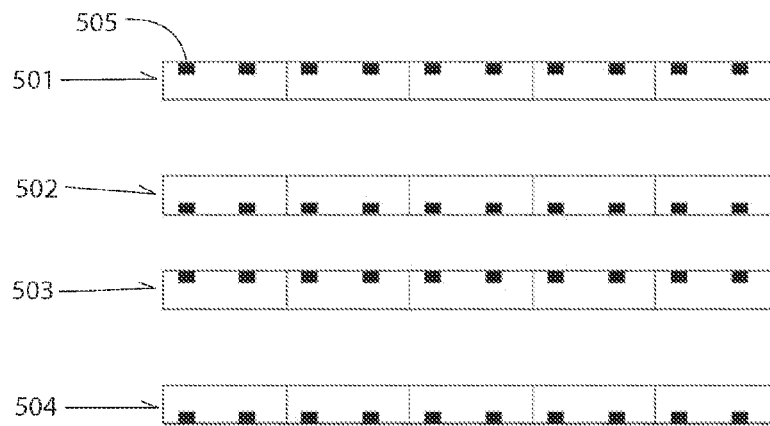


Fig. 43

Fig. 44



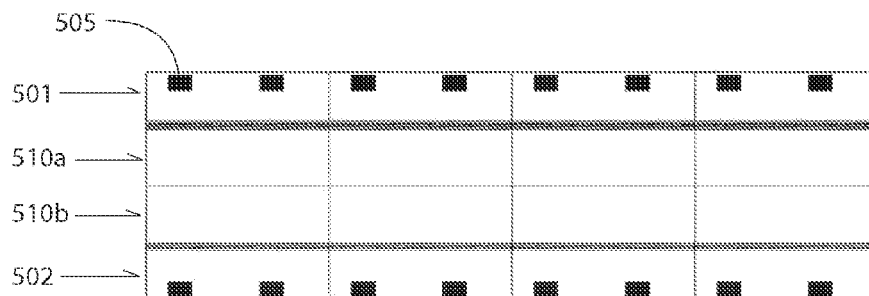


Fig. 45

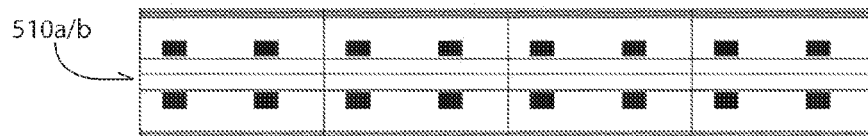
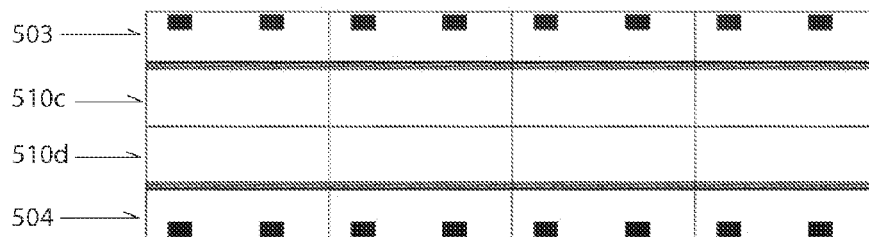


Fig. 46

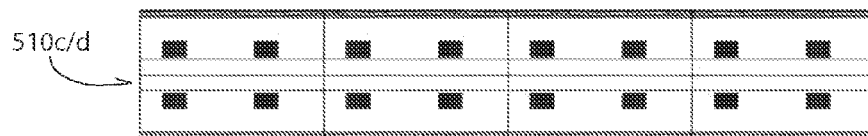


Fig. 47

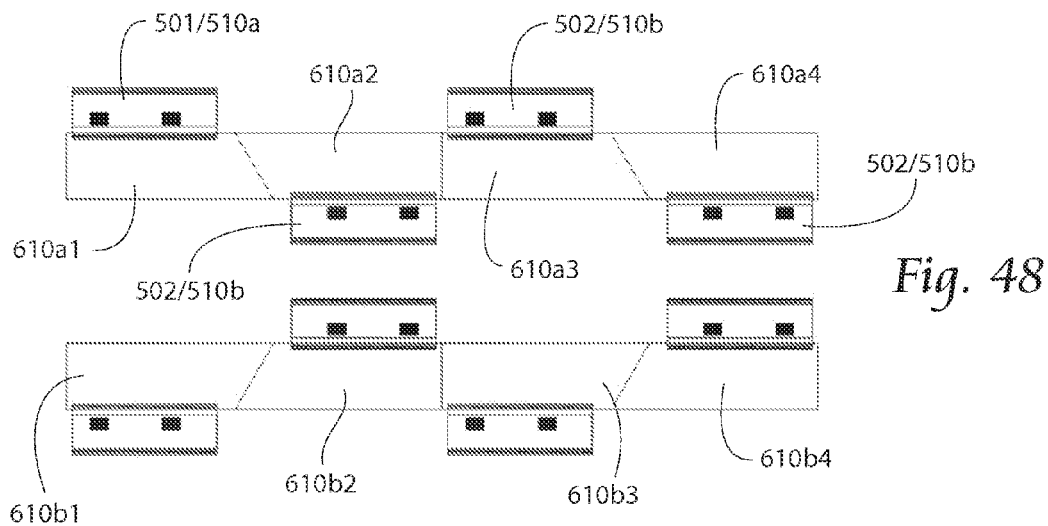
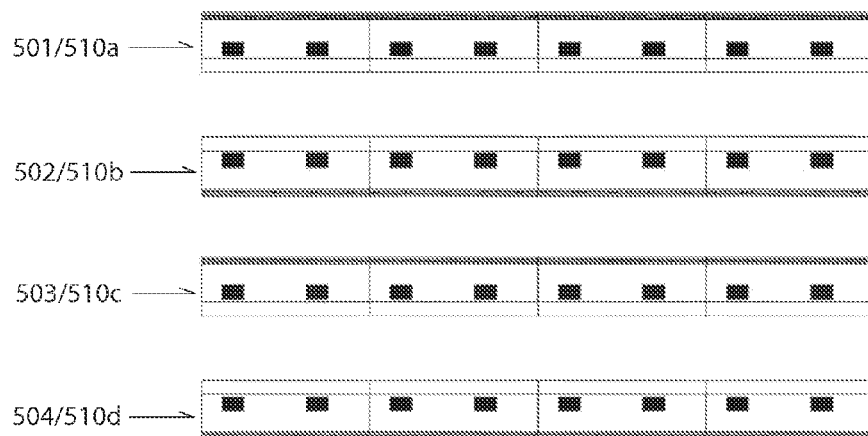
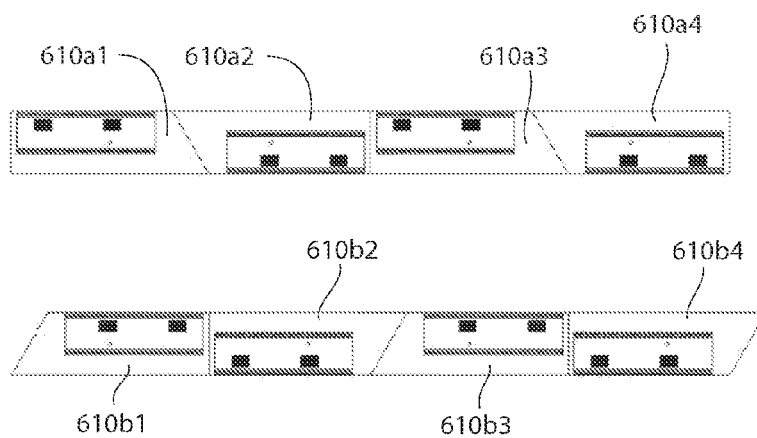


Fig. 48

Fig. 49



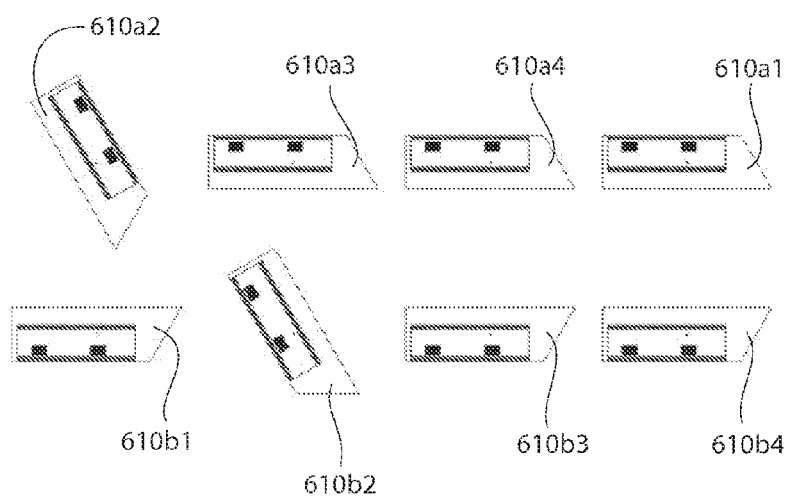
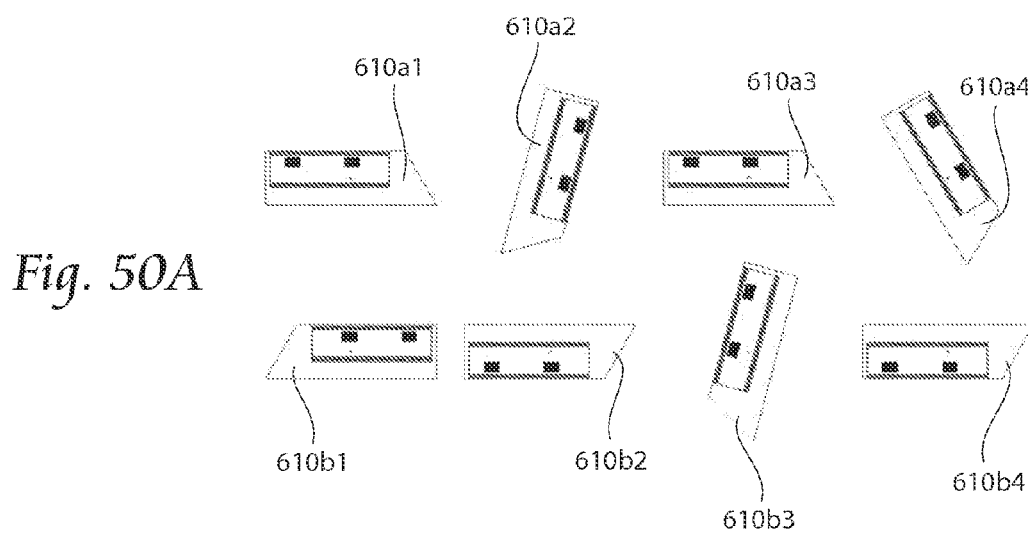


Fig. 50B

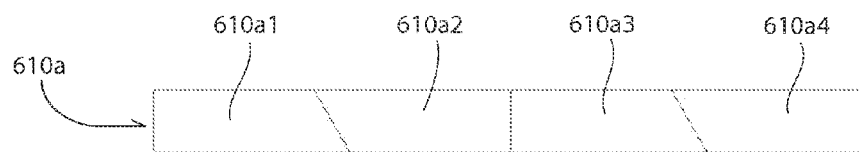
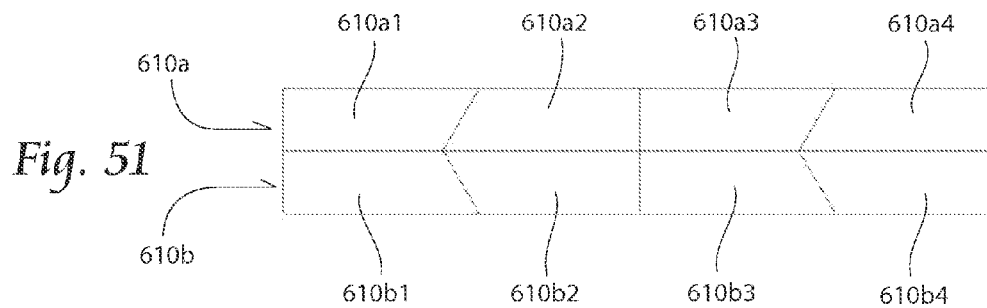
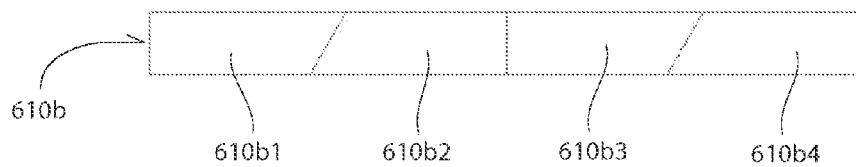


Fig. 52



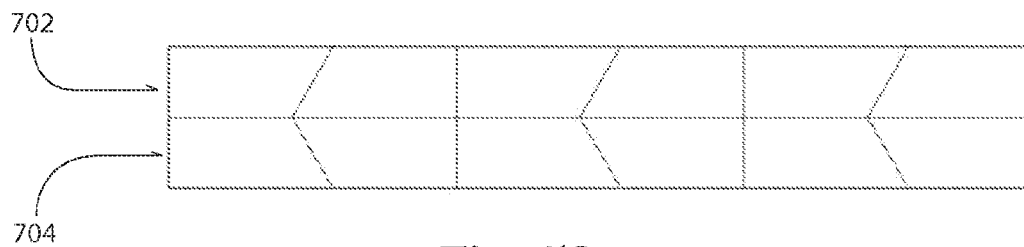


Fig. 53

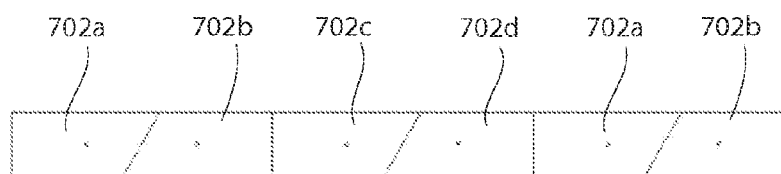


Fig. 54

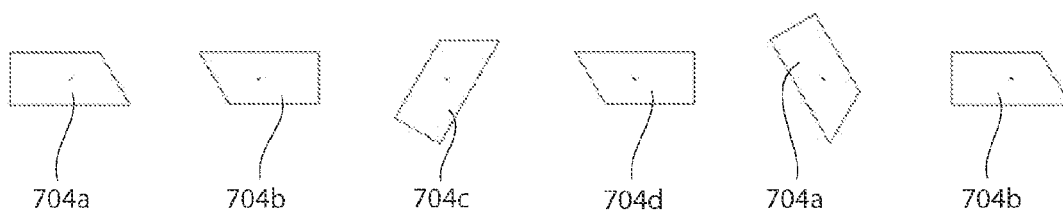
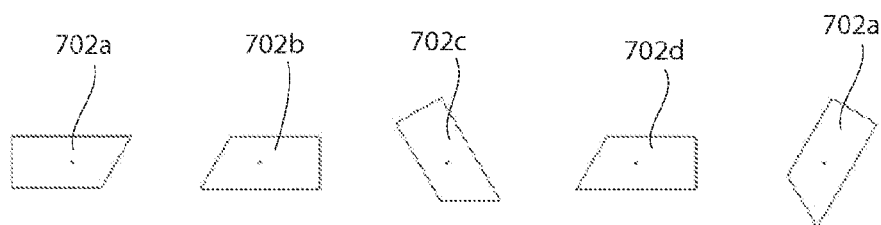
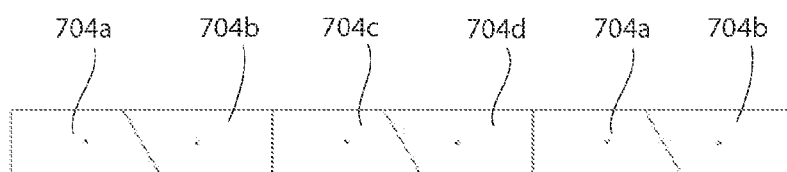


Fig. 55

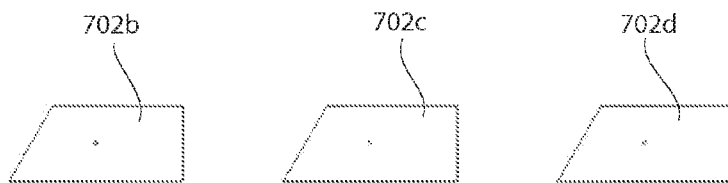


Fig. 56

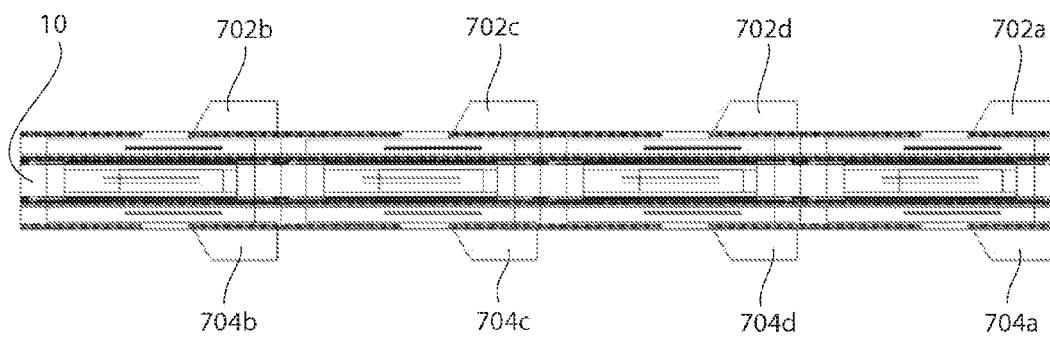
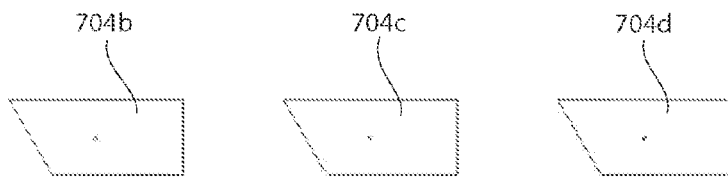


Fig. 57

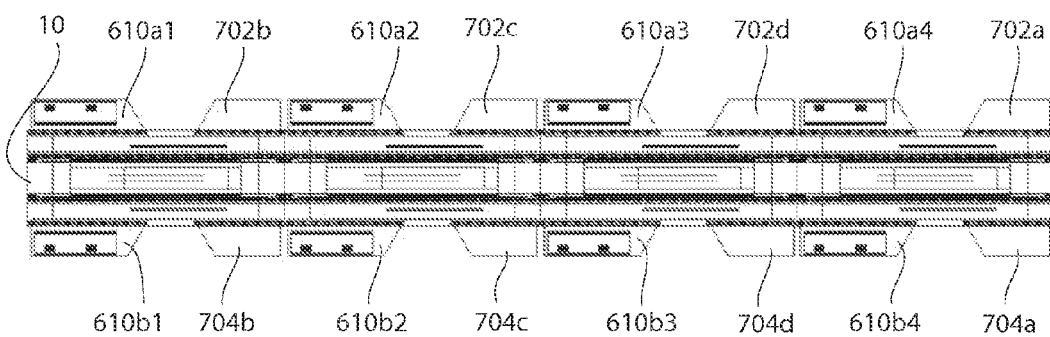


Fig. 58

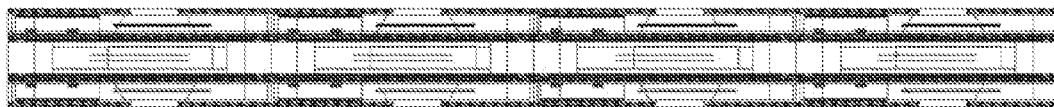


Fig. 59

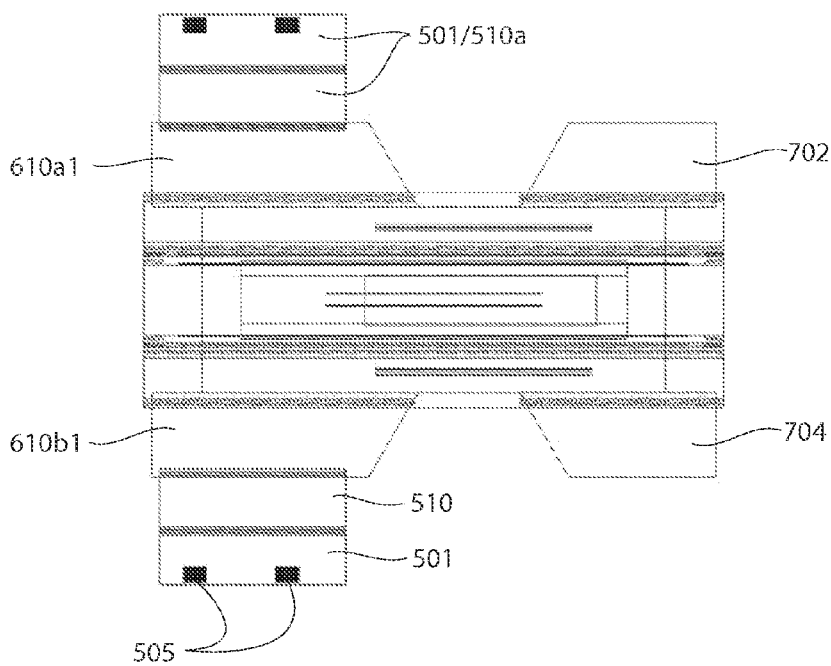


Fig. 60

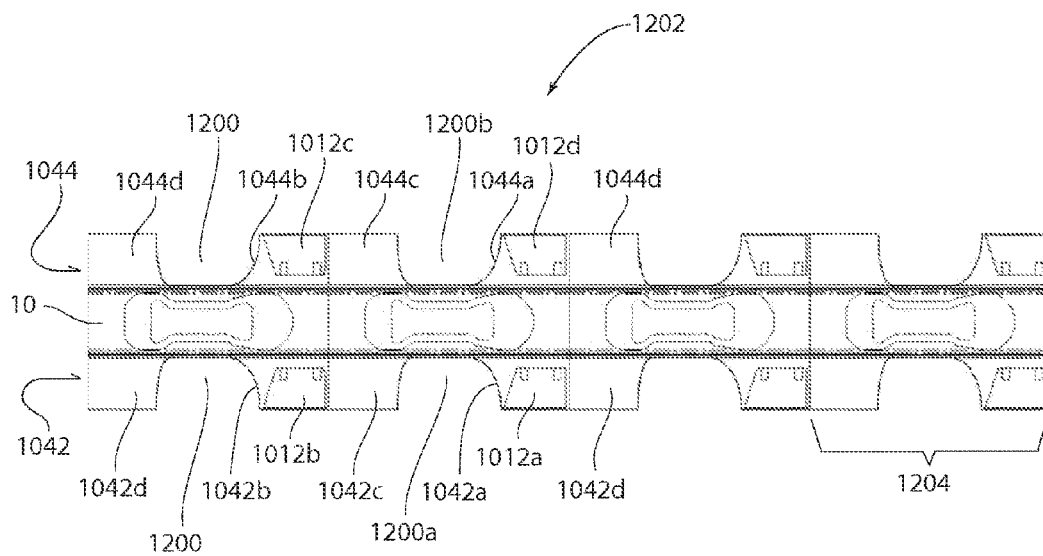


Fig. 61

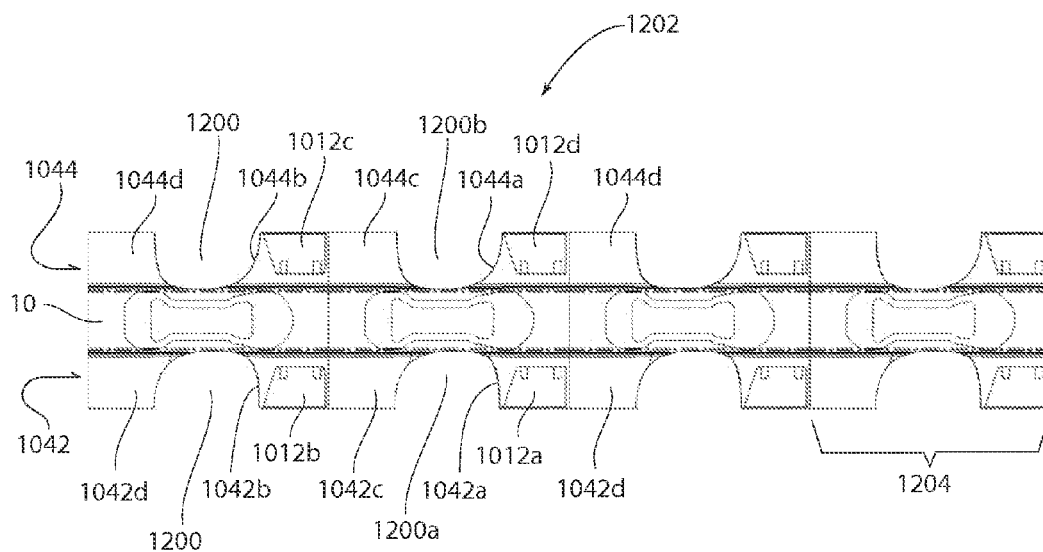
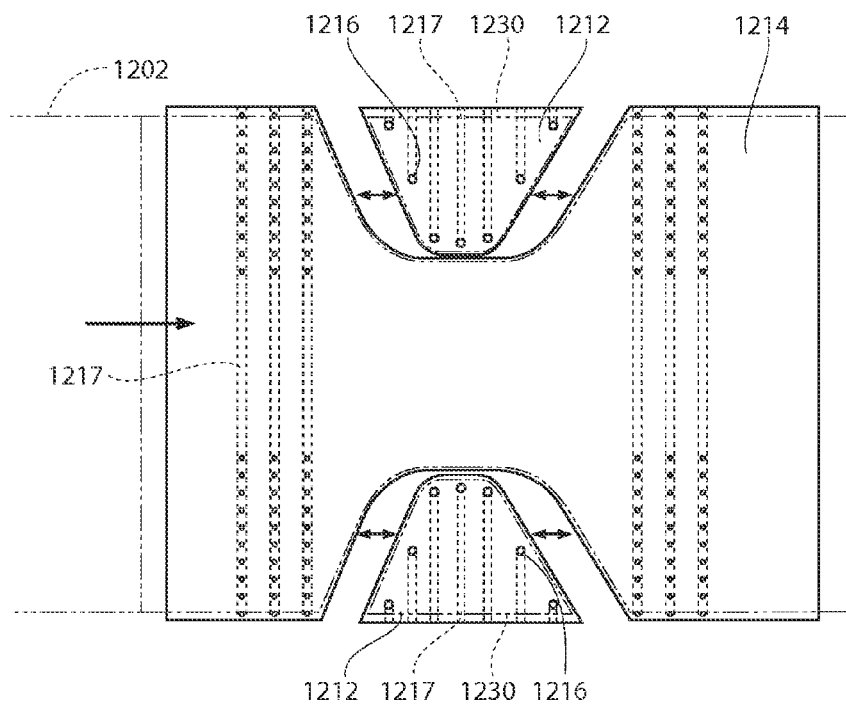
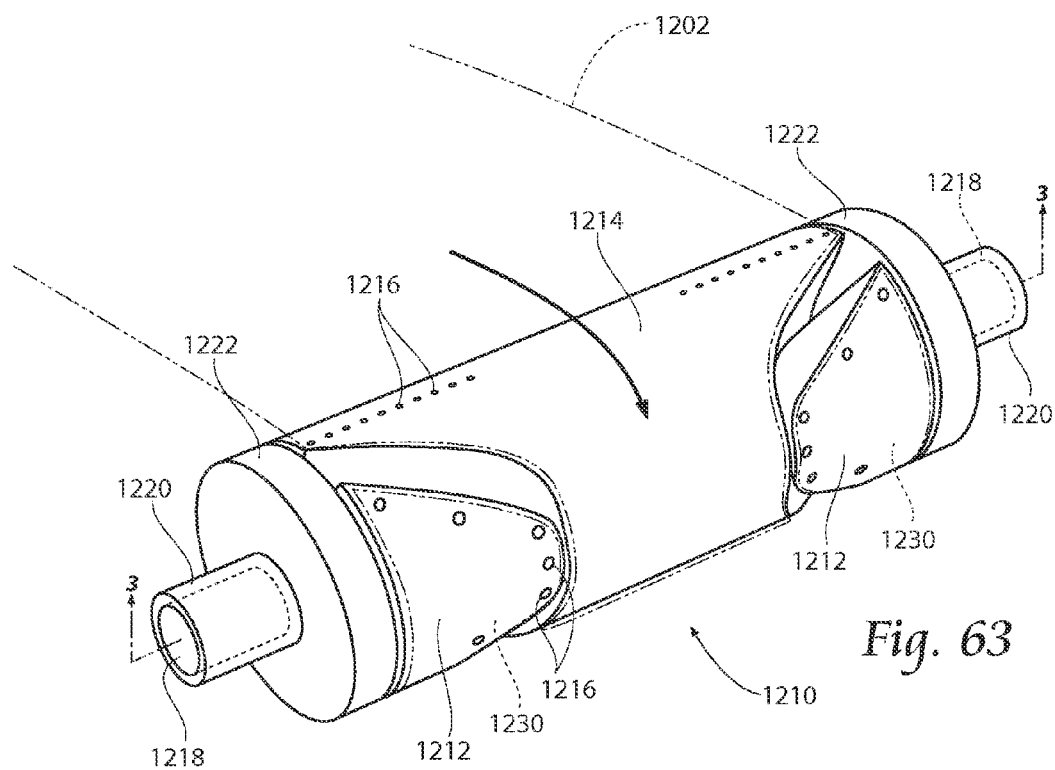


Fig. 62



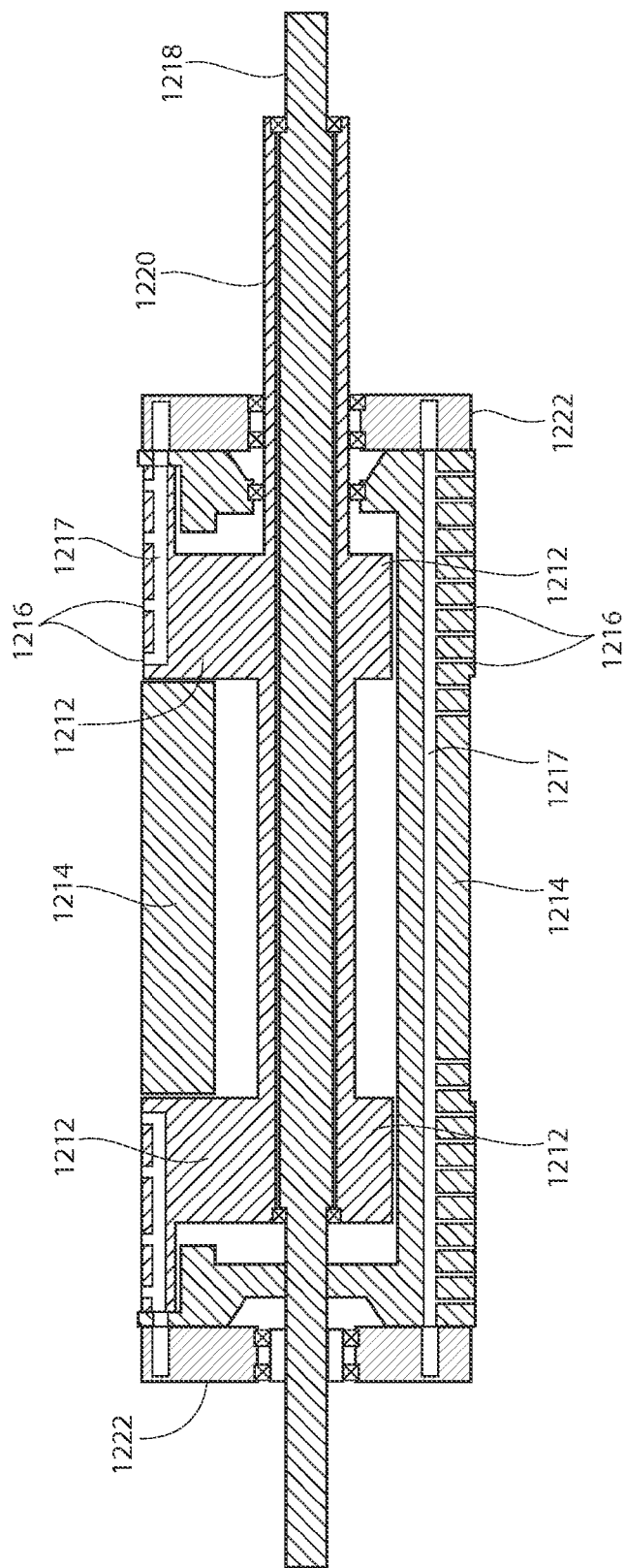
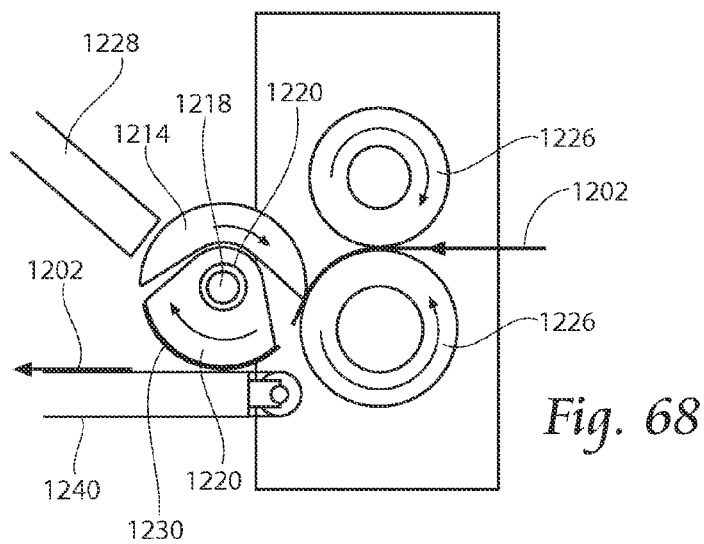
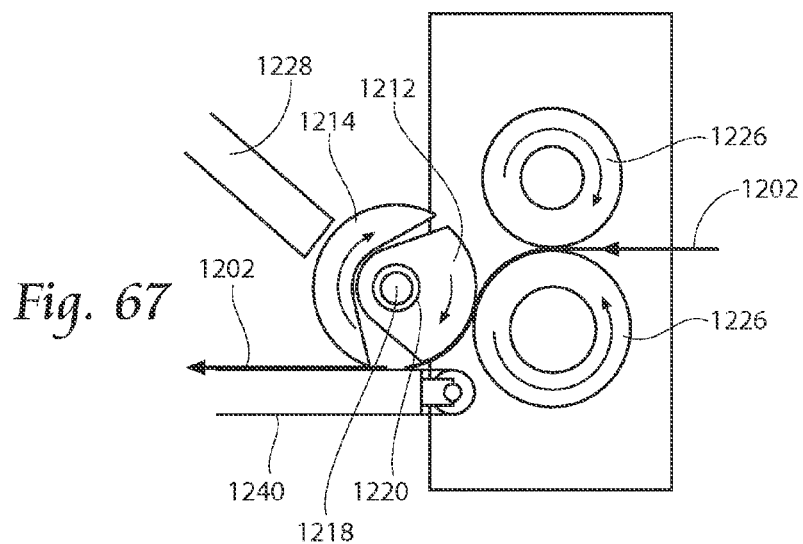
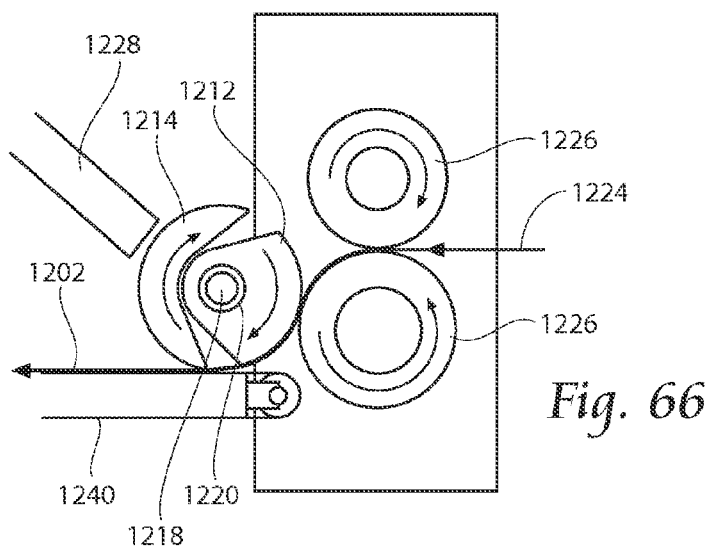
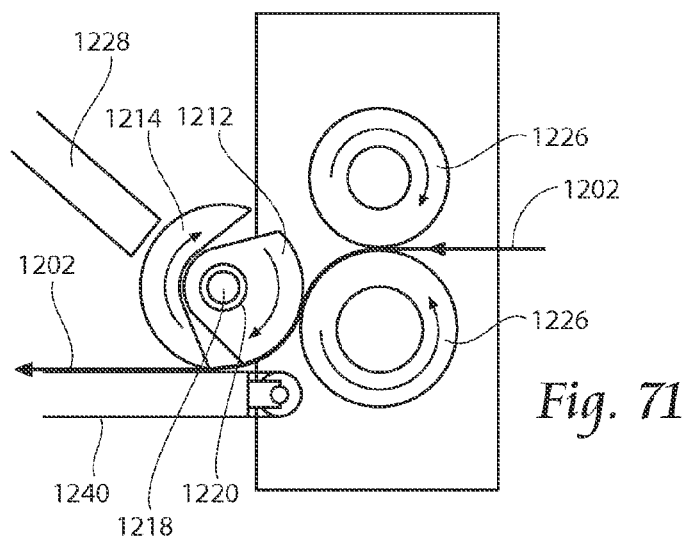
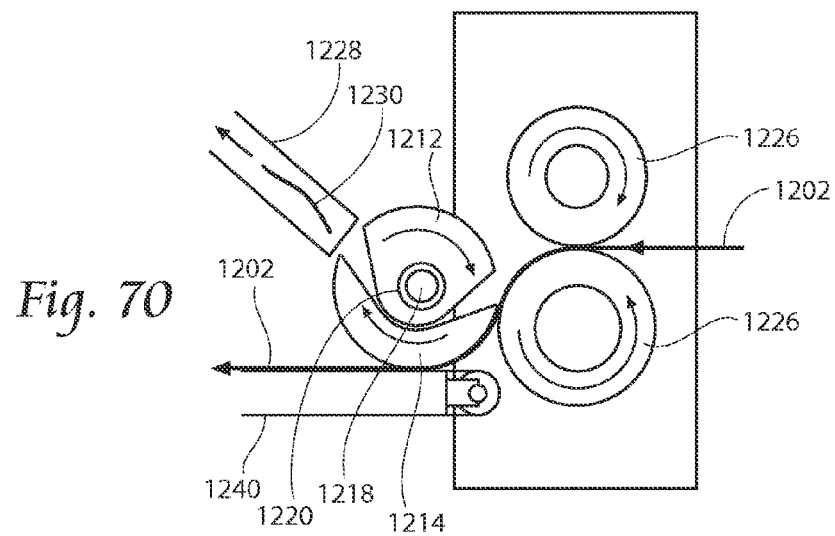
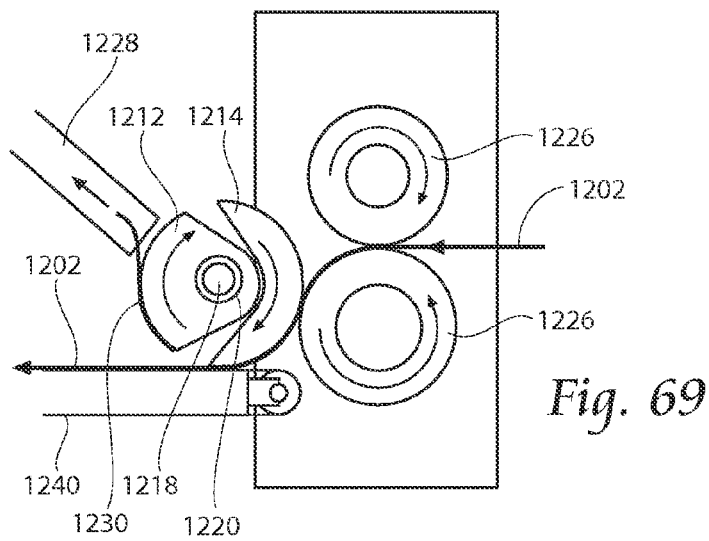


Fig. 65





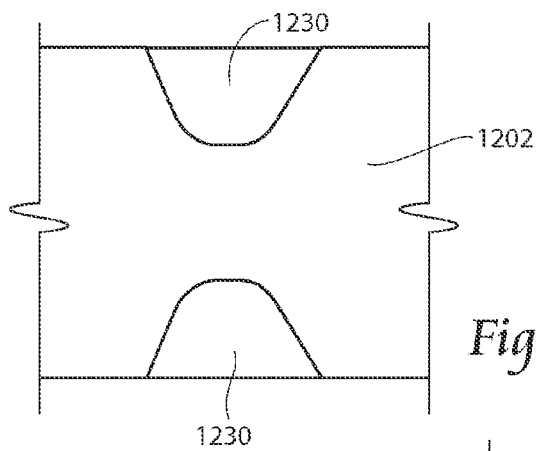


Fig. 72

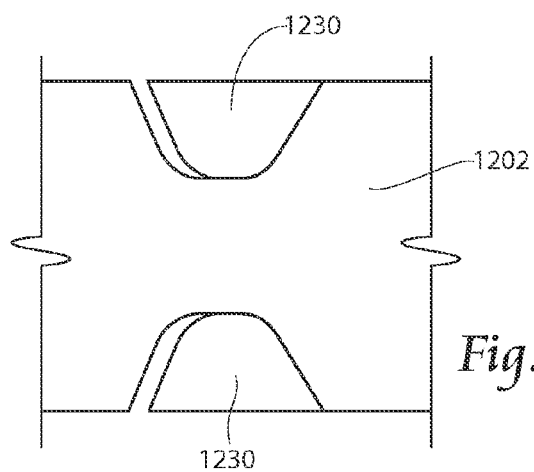


Fig. 73

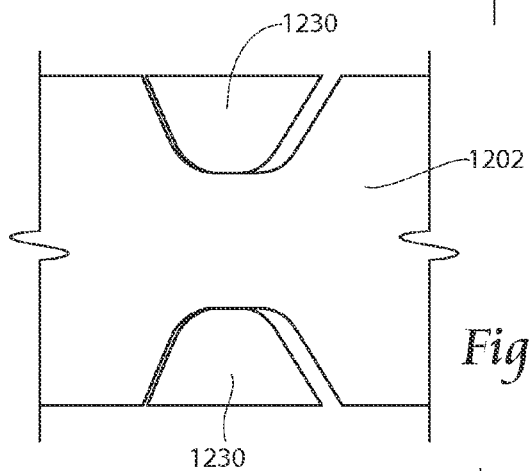


Fig. 74

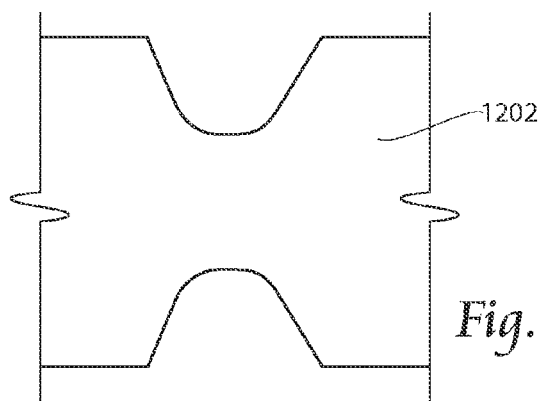


Fig. 75

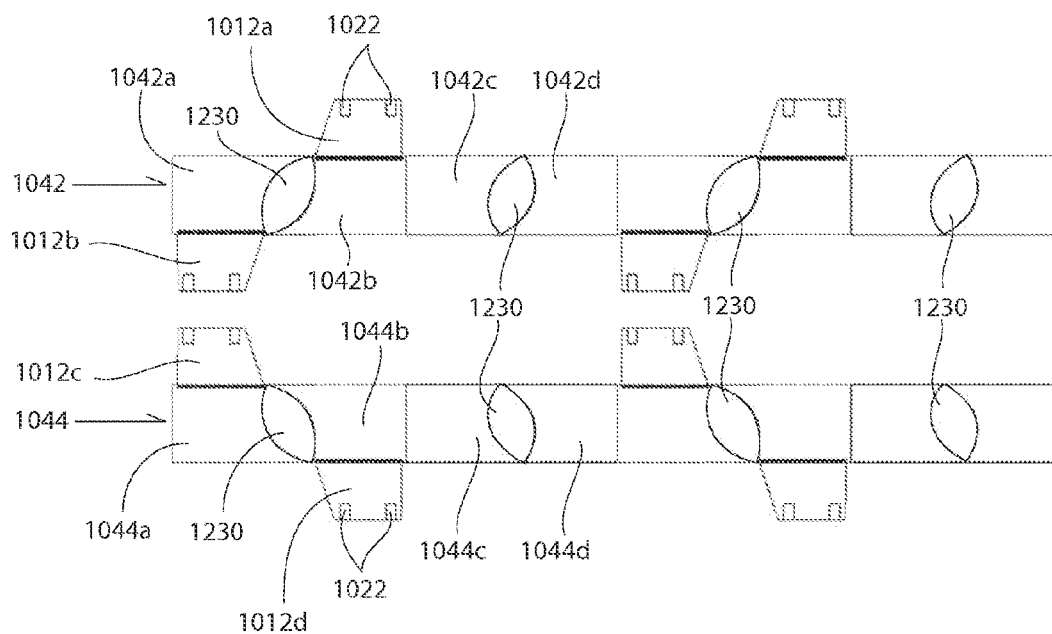


Fig. 76

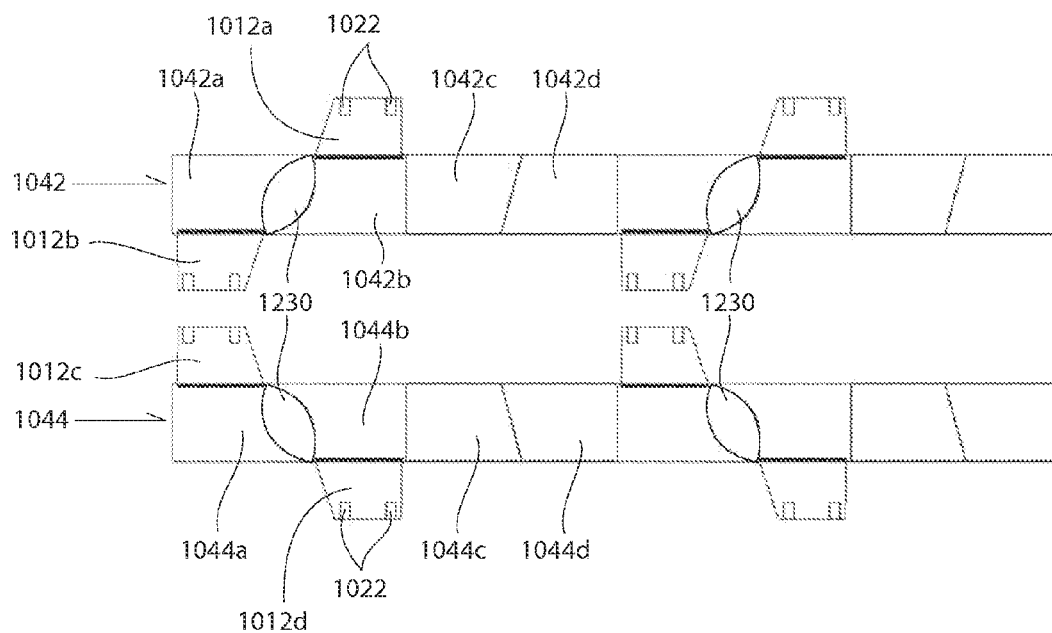


Fig. 77

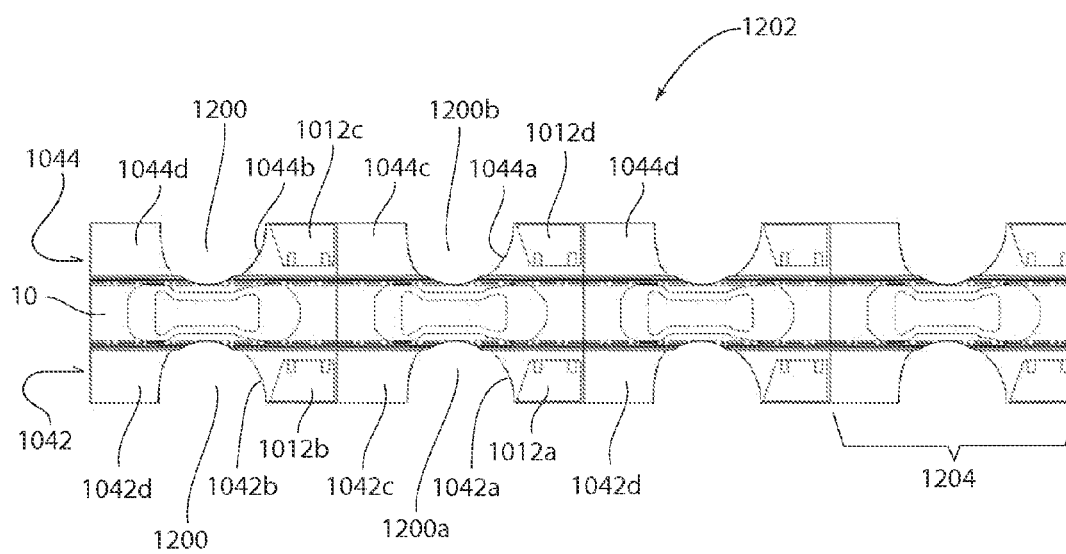


Fig. 78

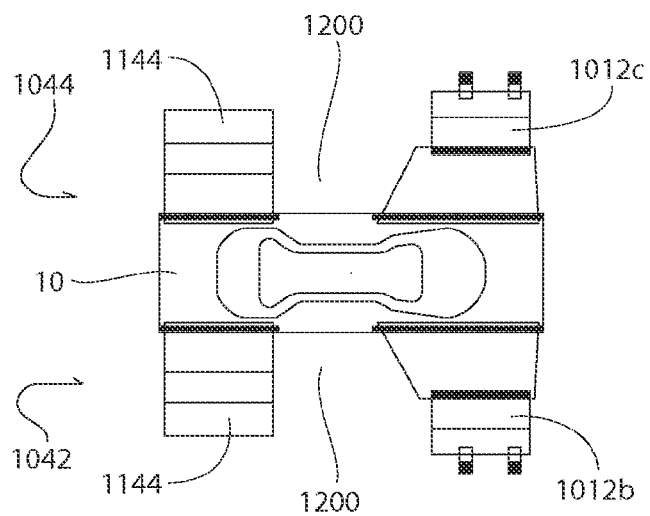


Fig. 79

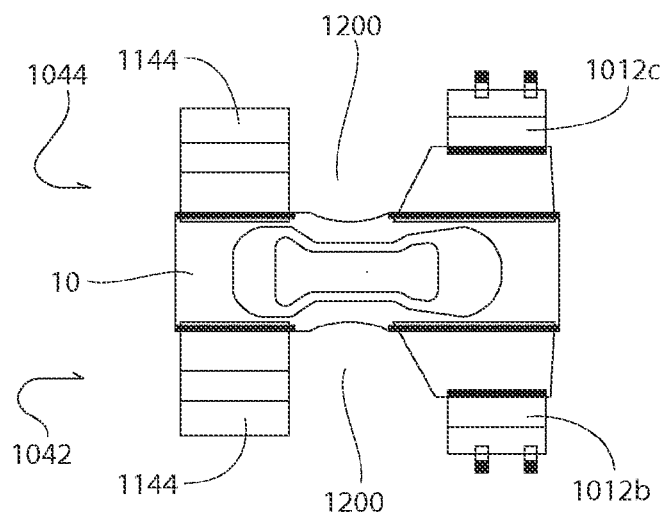


Fig. 80

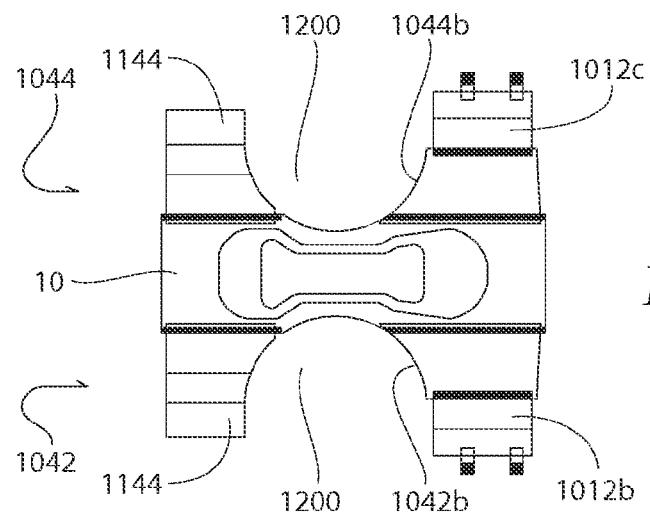


Fig. 81

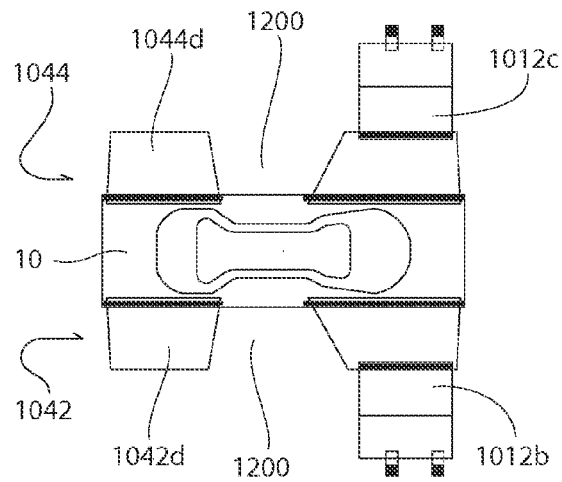


Fig. 82

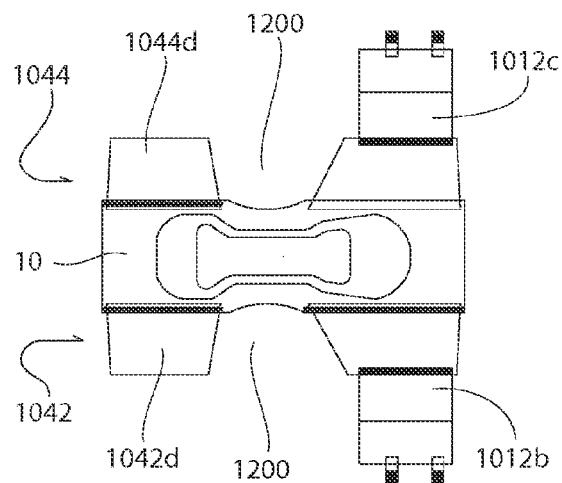


Fig. 83

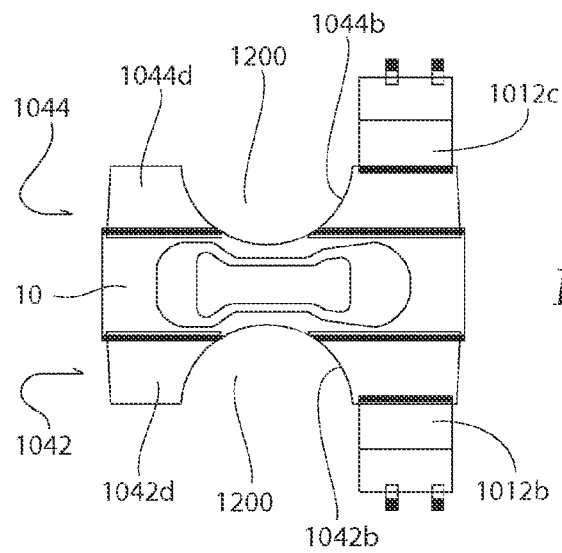


Fig. 84

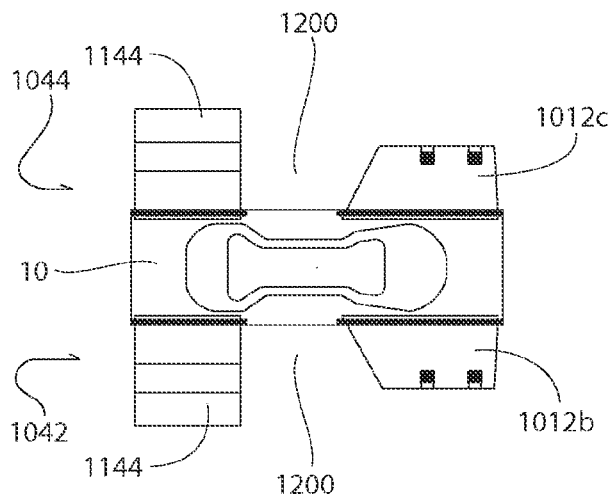


Fig. 85

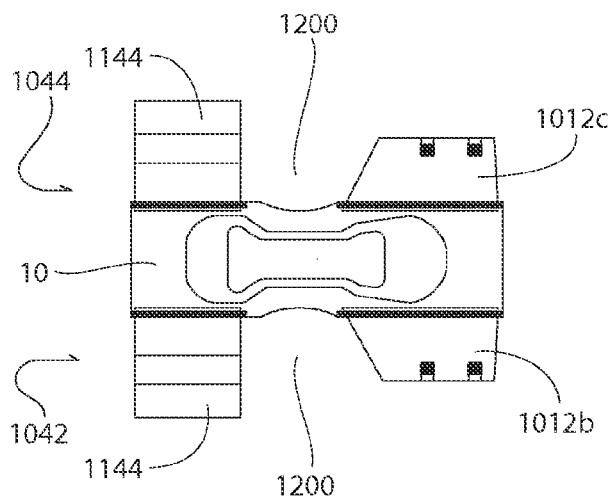


Fig. 86

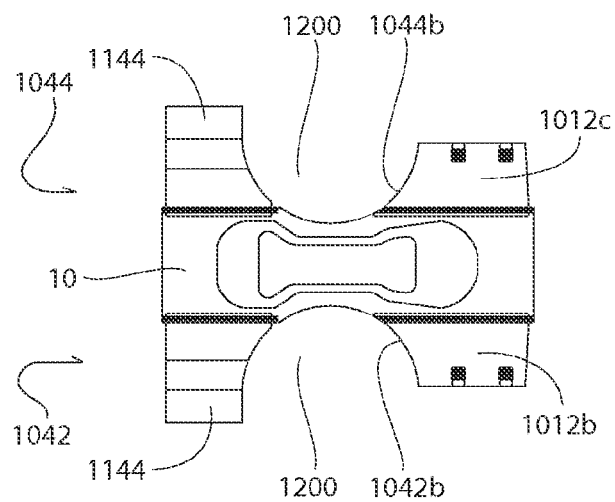


Fig. 87

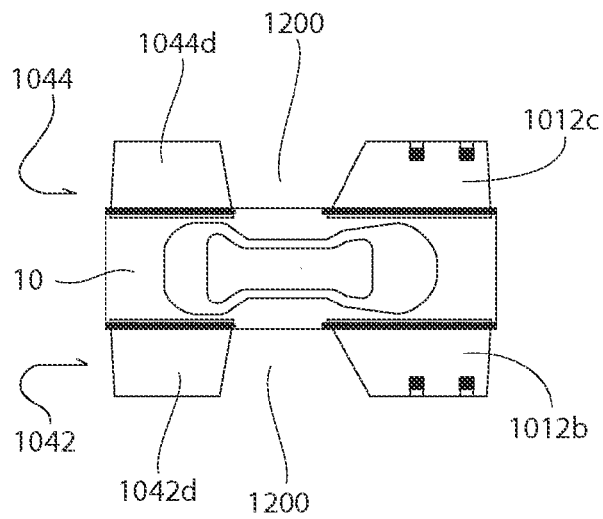


Fig. 88

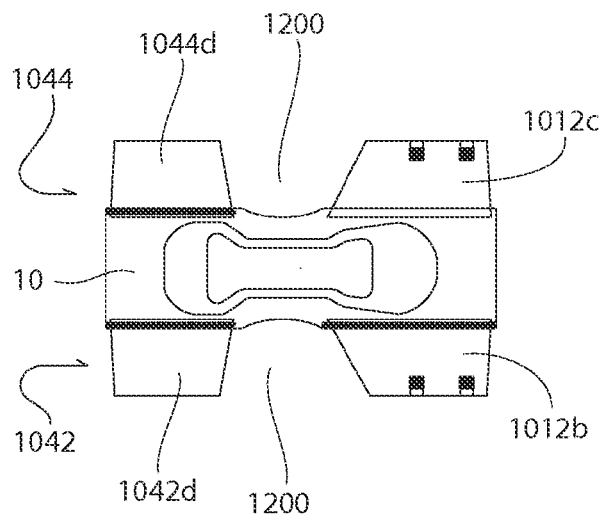


Fig. 89

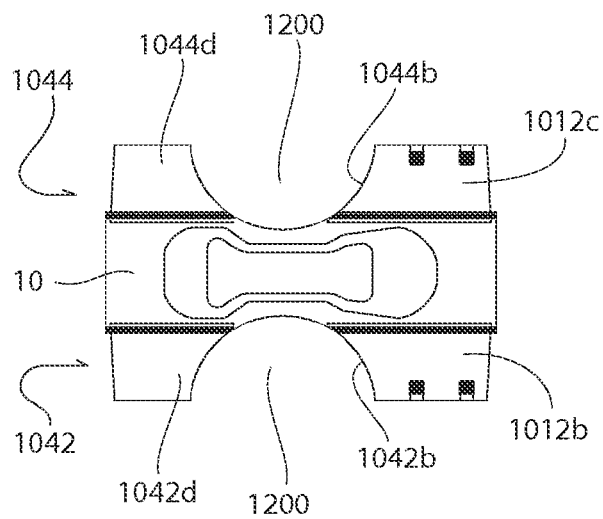


Fig. 90

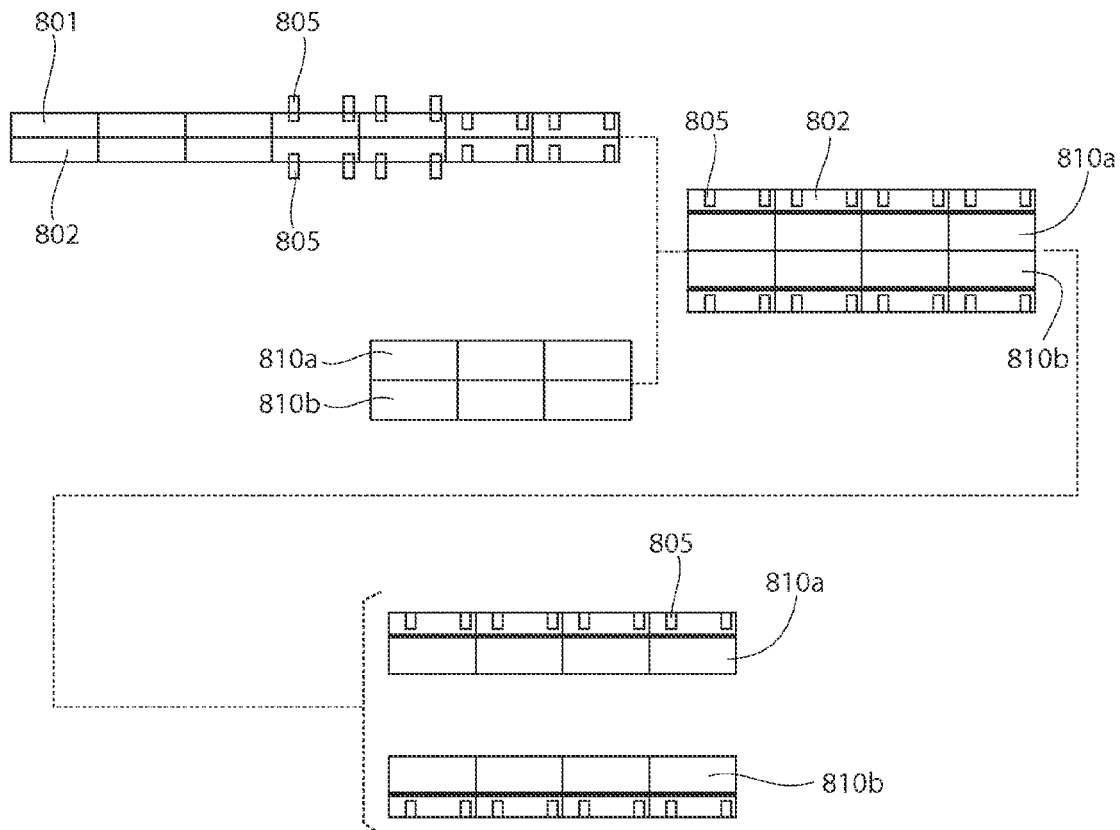


Fig. 91

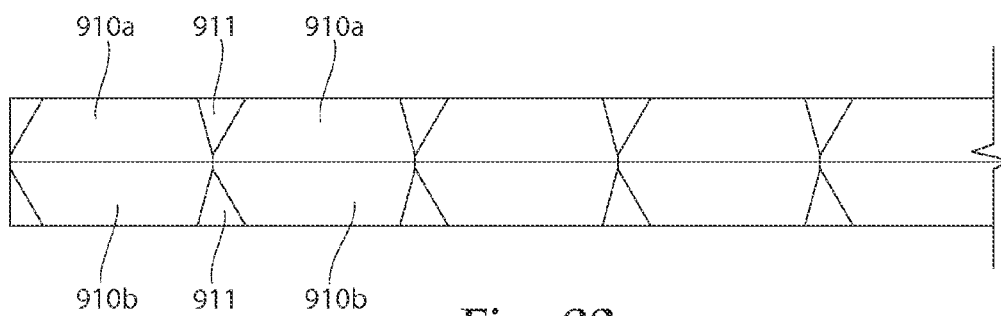


Fig. 92

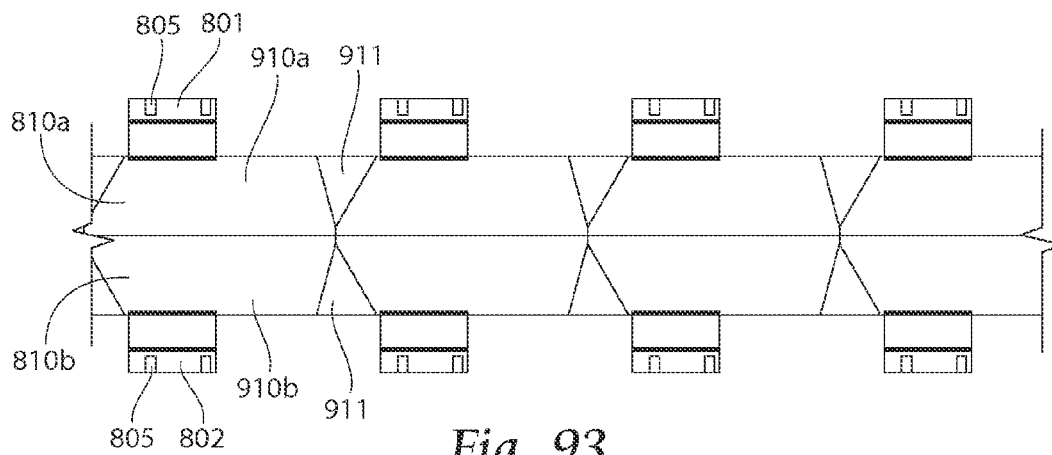


Fig. 93

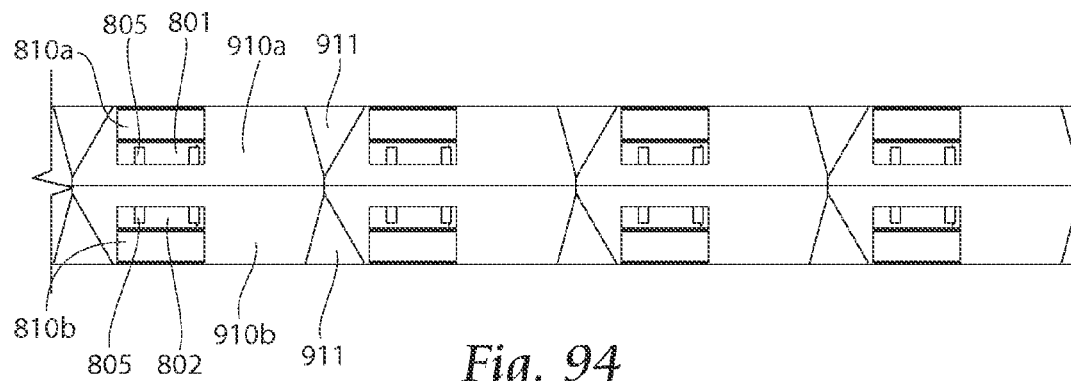


Fig. 94

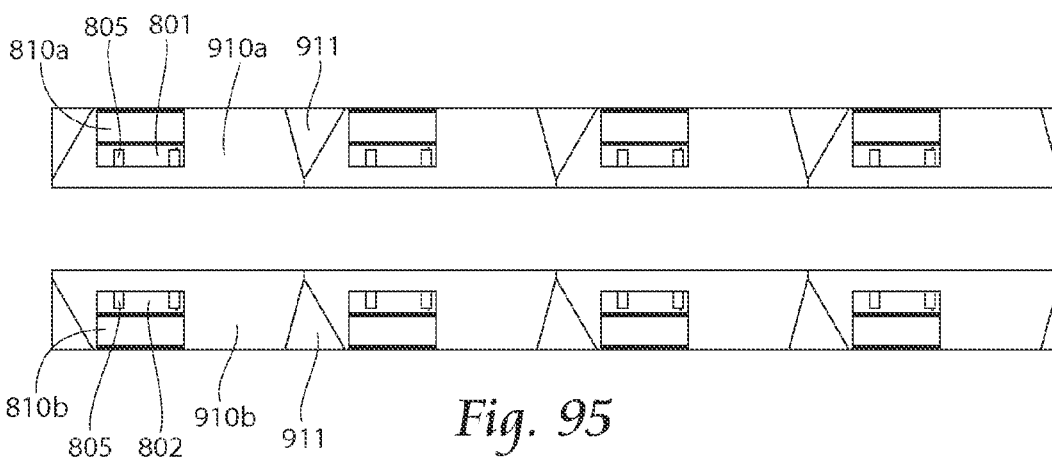


Fig. 95

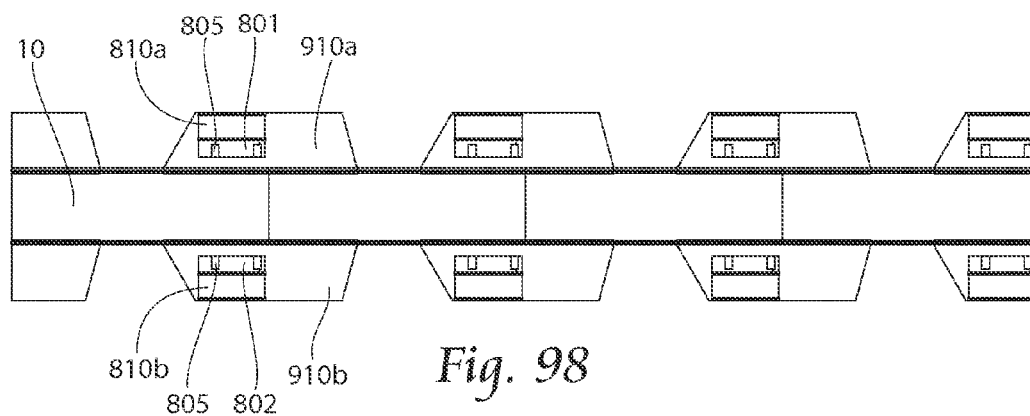
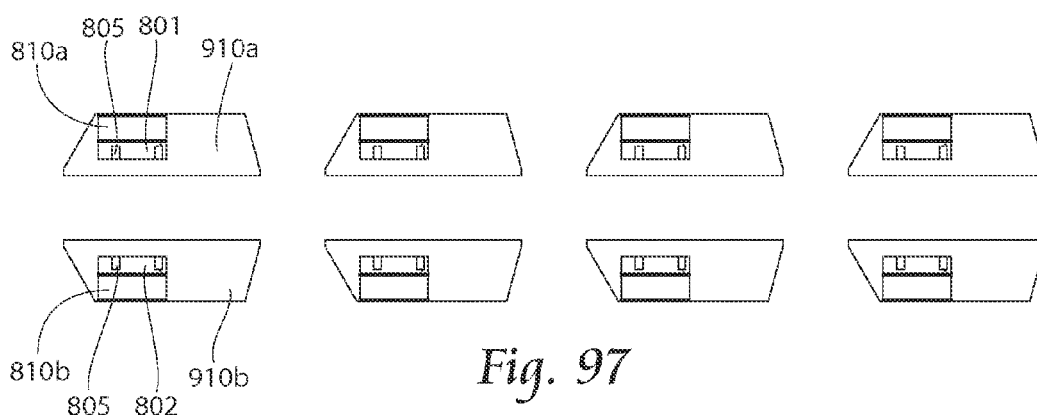
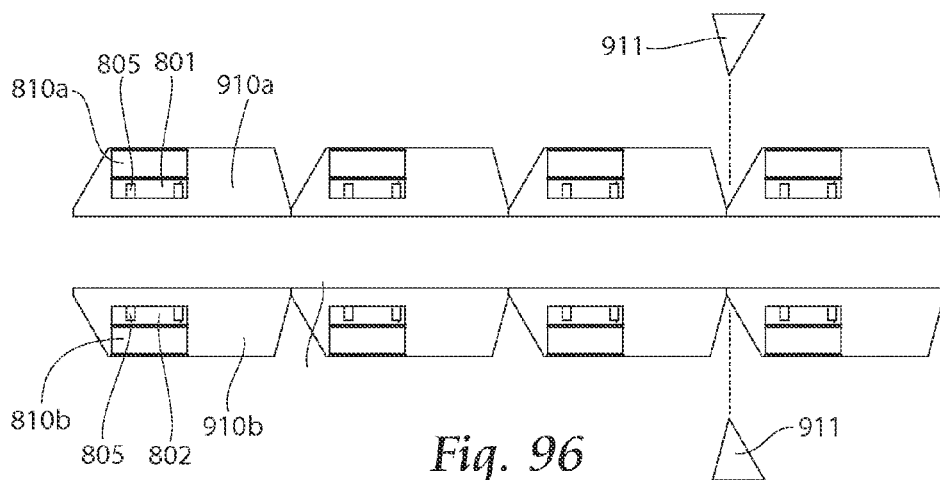


Fig. 99

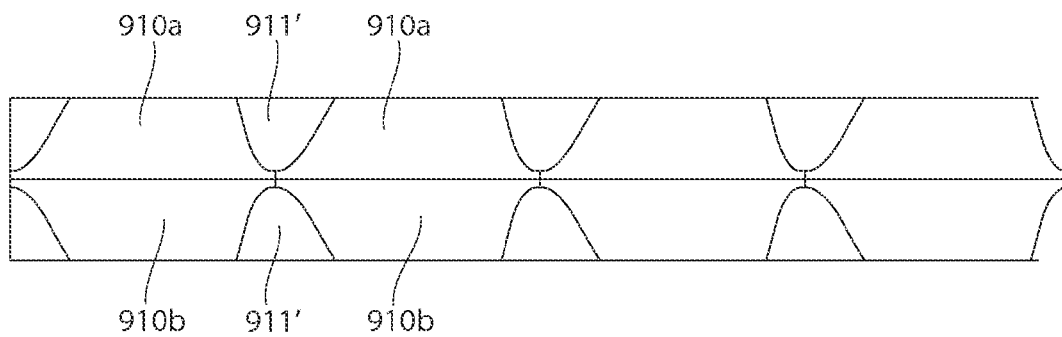
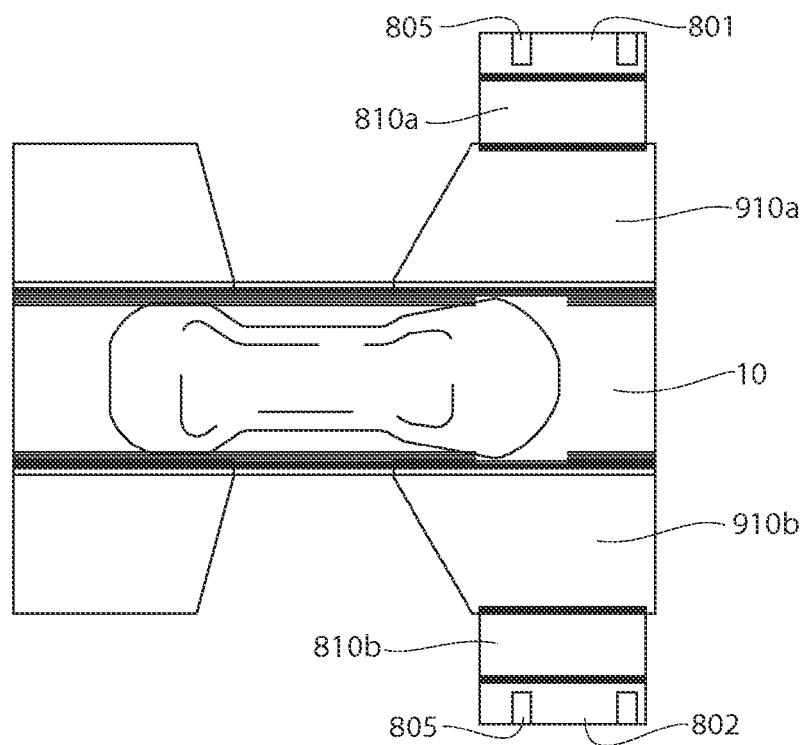
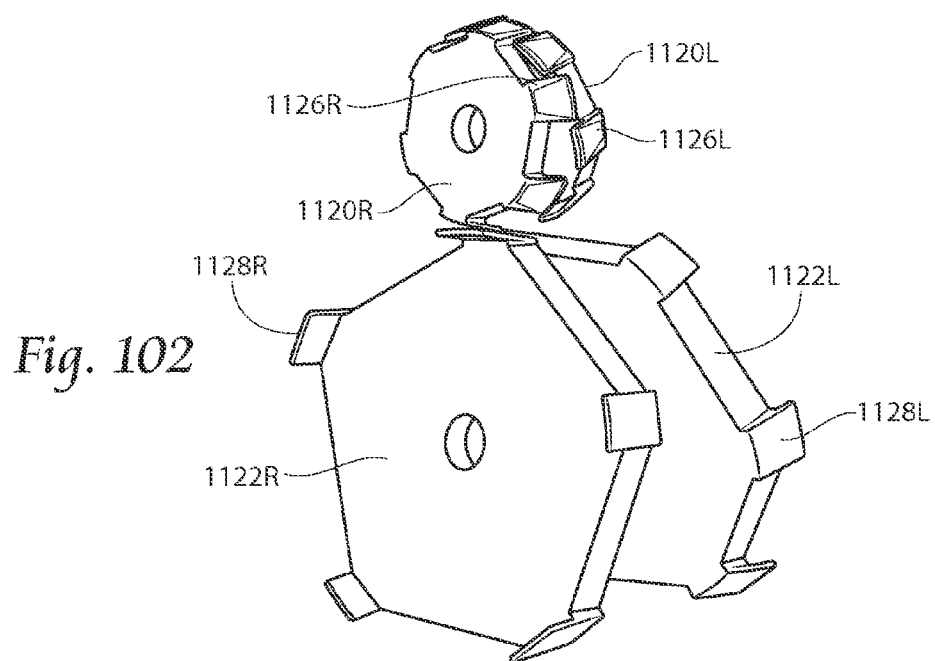
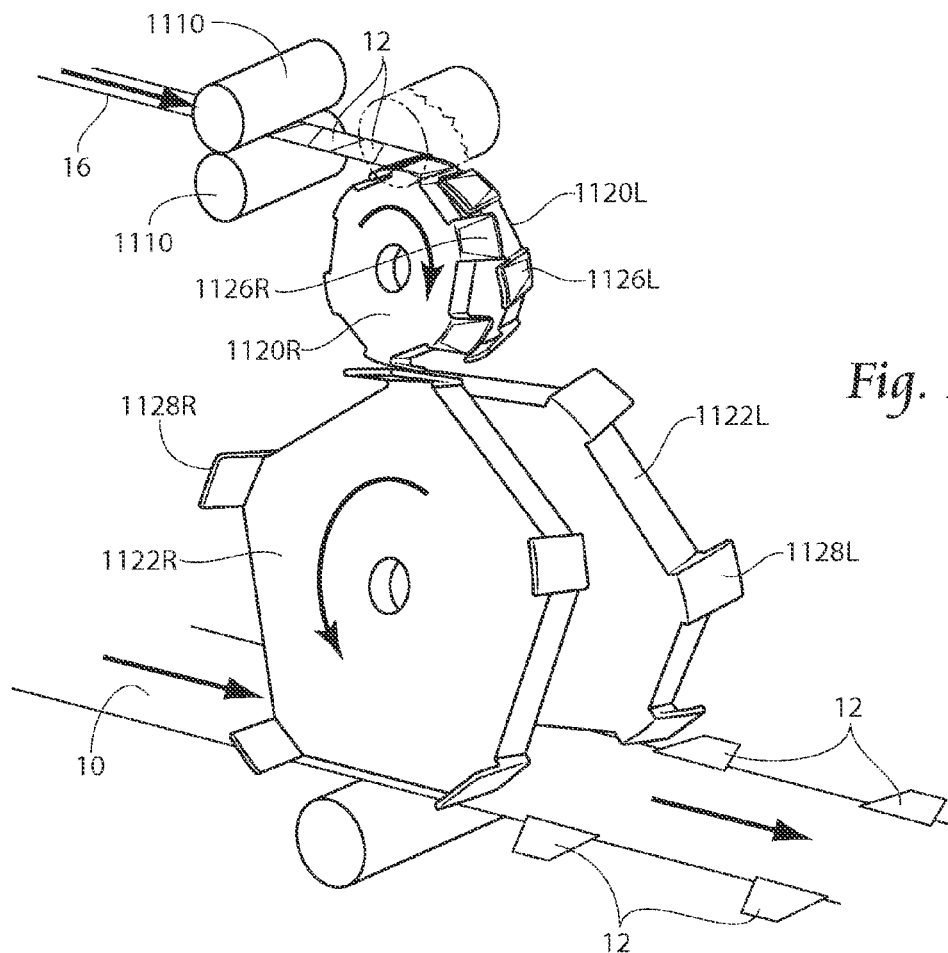
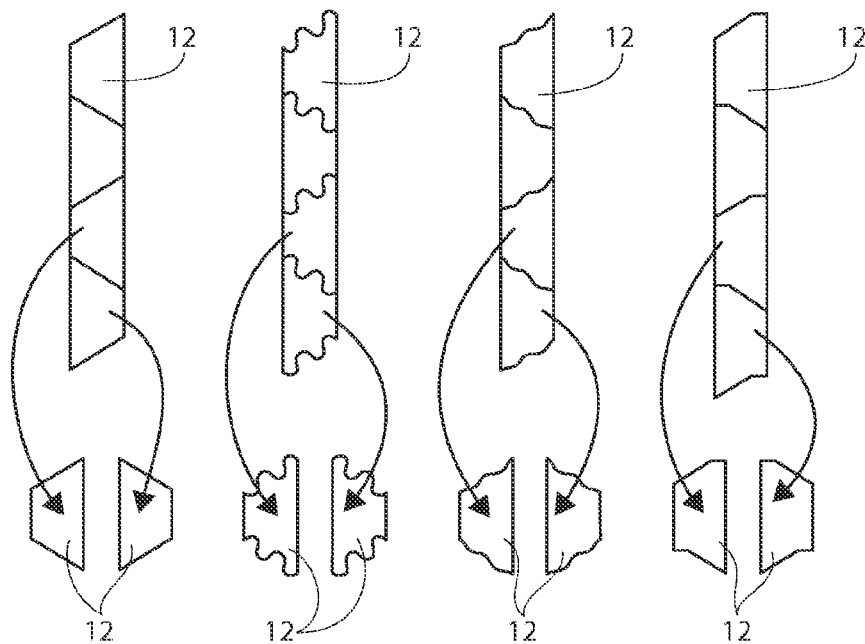
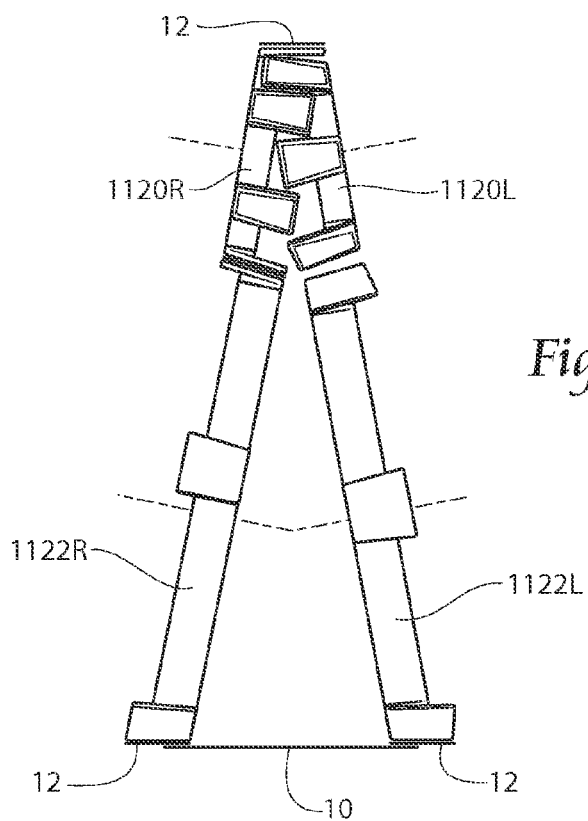


Fig. 100





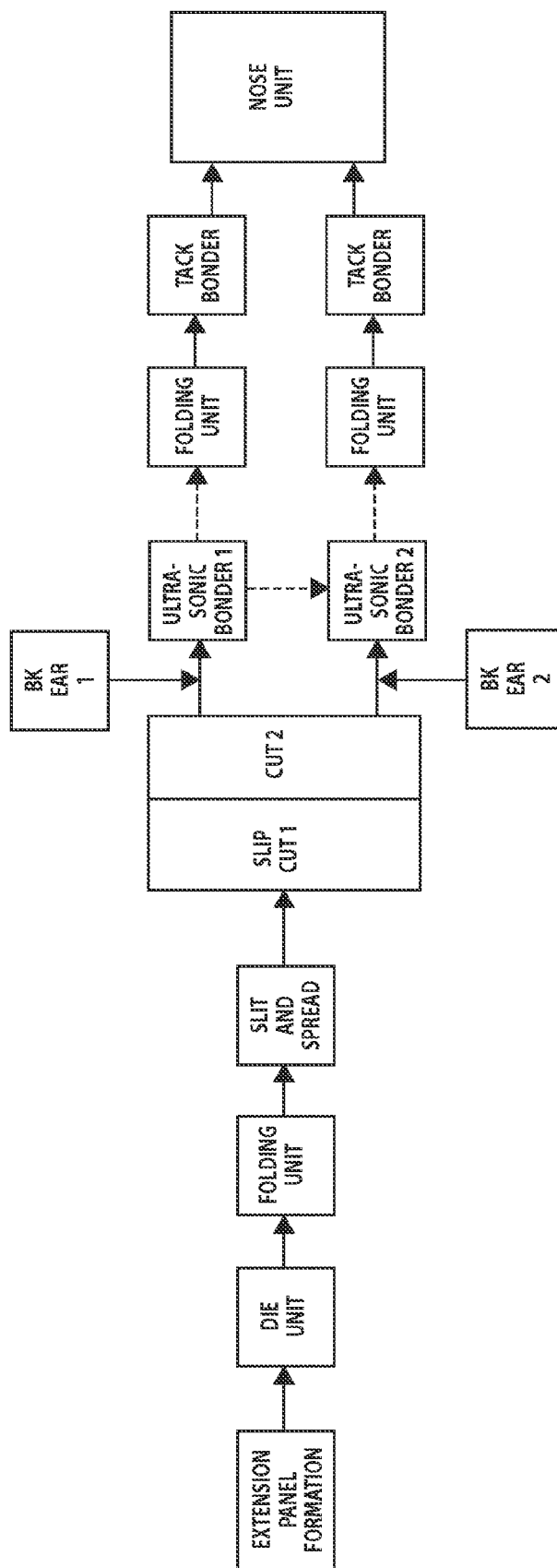
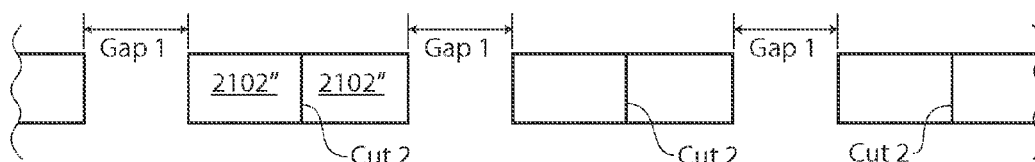
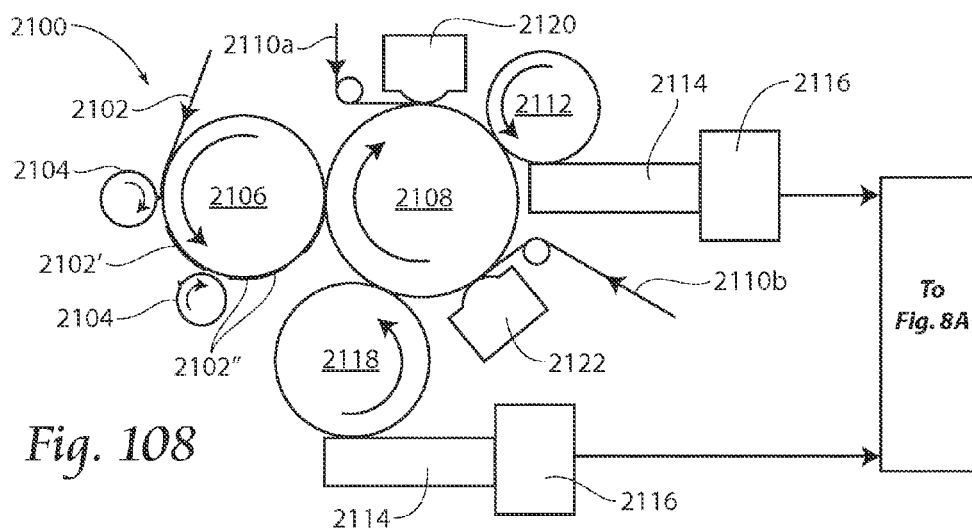
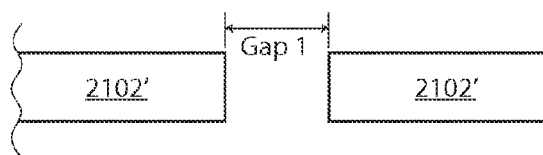
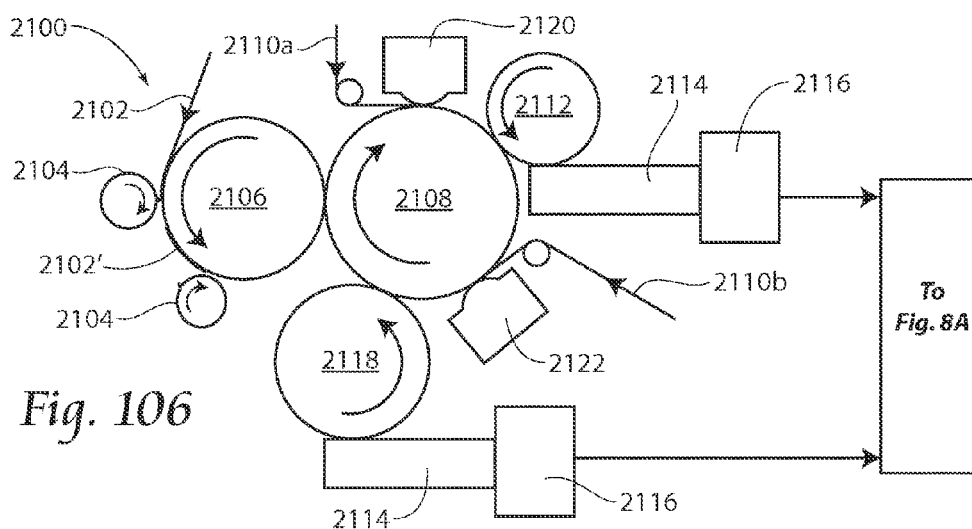
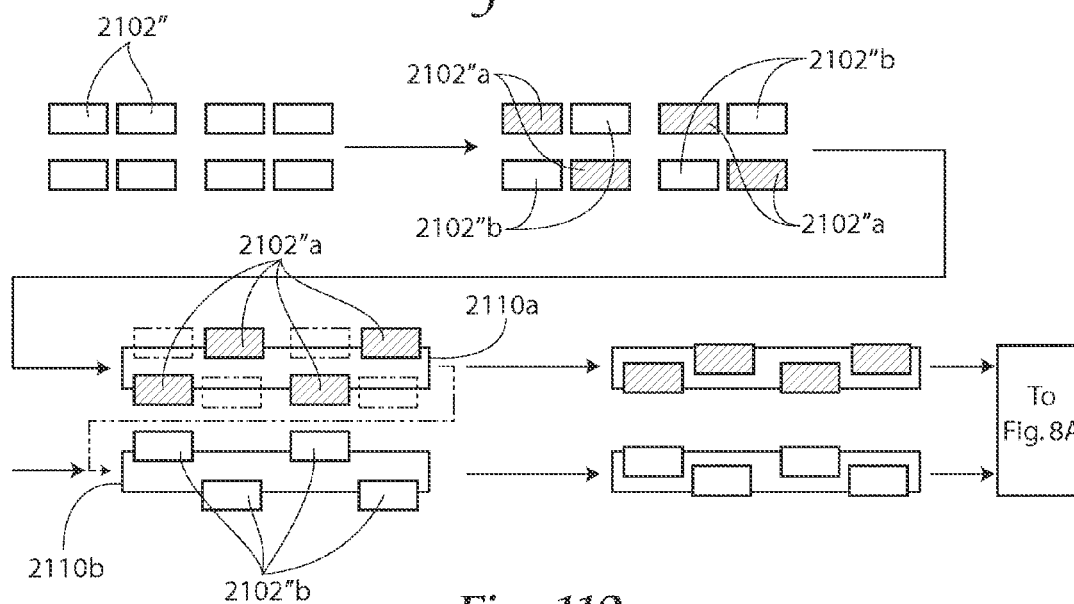
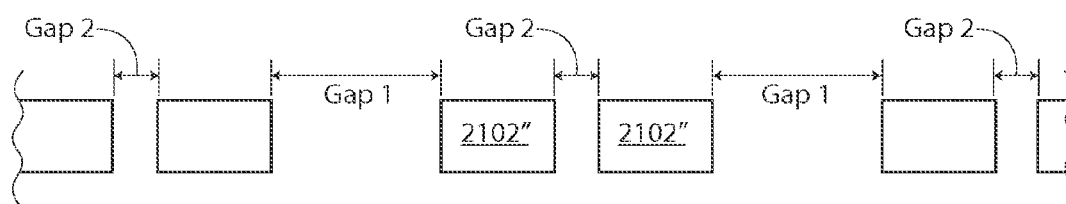
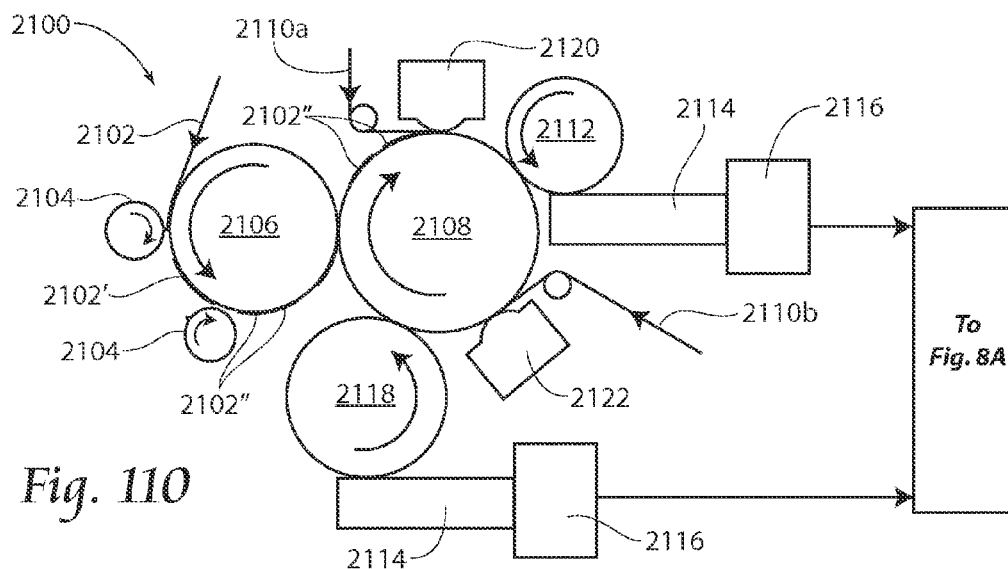


Fig. 105





1

**METHODS AND APPARATUS FOR
APPLICATION OF NESTED ZERO WASTE
EAR TO TRAVELING WEB AND
FORMATION OF ARTICLES USING A DUAL
CUT SLIP UNIT**

RELATED APPLICATIONS

This application claims the benefit of co-pending Provisional Patent Application Ser. No. 61/547,474, filed on 14 Oct. 2011. This application is also a continuation-in-part of U.S. application Ser. No. 12/925,033, filed on 12 Oct. 2010, which is a continuation-in-part of U.S. application Ser. No. 12/798,520 filed on 5 Apr. 2010 (now U.S. Pat. No. 8,172,977), which in turn claims the benefit of U.S. Provisional Application Ser. No. 61/212,011 filed on 6 Apr. 2009 and U.S. Provisional Application Ser. No. 61/212,619 filed on 14 Apr. 2009. This application is also a continuation-in-part of application Ser. No. 12/151,667 filed 8 May, 2008 (now U.S. Pat. No. 8,106,972), which claims the benefit of U.S. Provisional Application Ser. No. 60/928,305 filed 9 May 2007. This application is also a continuation-in-part of U.S. application Ser. No. 12/806,891 filed on 24 Aug. 2010 which is a continuation U.S. application Ser. No. 11/436,274, filed on 18 May 2006 (now U.S. Pat. No. 7,780,052).

BACKGROUND OF THE INVENTION

The present invention relates to disposable hygiene products and more specifically, to methods and apparatuses for processing disposable hygiene products. More specifically, the invention relates to cutting and applying segments of one web to attach to a disposable diaper.

The invention disclosed herein also relates to apparatus and methods for waste reduction. Generally, diapers comprise an absorbent insert or patch and a chassis, which, when the diaper is worn, supports the insert proximate a wearer's body. Additionally, diapers may include other various patches, such as tape tab patches, reusable fasteners and the like. The raw materials used in forming a representative insert are typically cellulose pulp, tissue paper, poly, non-woven web, acquisition, and elastic, although application specific materials are sometimes utilized. Usually, most of the insert raw materials are provided in roll form, and unwound and applied in assembly line fashion. As in many manufacturing operations, waste minimization is a goal in web processing applications, as products having spliced raw materials cannot be sold to consumers. Indeed, due to the rate at which web processing machines run, even minimal waste can cause inefficiencies of scale.

In present systems, waste materials are recycled. However, the act of harvesting recyclable materials from defective product is intensive. That is, recyclable materials are harvested only after an identification of a reject product at or near the end of a process. The result is that recyclable materials are commingled, and harvesting requires the extra step of separating waste components. Therefore, it is beneficial to use up all of incoming rolls, so that a portion of the incoming rolls do not become waste. That objective is accomplished with the present invention

When manufacturing hygiene products, such as baby diapers, adult diapers, disposable undergarments, incontinence devices, sanitary napkins and the like, a common method of applying discrete pieces of one web to another is by use of a slip-and-cut applicator. A slip-and-cut applicator is typically comprised of a cylindrical rotating vacuum anvil, a rotating knife roll, and a transfer device. In typical

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applications, an incoming web is fed at a relatively low speed along the vacuum face of the rotating anvil, which is moving at a relatively higher surface speed and upon which the incoming web is allowed to "slip". A knife-edge, mounted on the rotating knife roll, cuts a off a segment of the incoming web against the anvil face. This knife-edge is preferably moving at a surface velocity similar to that of the anvil's surface. Once cut, the web segment is held by vacuum drawn through holes on the anvil's face as it is carried at the anvil's speed downstream to the transfer point where the web segment is transferred to the traveling web.

Continual improvements and competitive pressures have incrementally increased the operational speeds of disposable diaper converters. As speeds increased, the mechanical integrity and operational capabilities of the applicators had to be improved accordingly.

SUMMARY OF THE INVENTION

The present invention allows for square, and non-square, and preferably trapezoidal, ear webs to be applied to a traveling web, with zero or minimized waste present in the incoming ear web. Zero material is wasted due to the geometry of the chosen ear pattern and its downstream processing.

An ear is a component of a diaper that is grasped and pulled around the waist of a wearer. Typically, ears are secured to the diaper at a first end, and a second free end is typically equipped with securing means, such as a pressure sensitive adhesive, or hook and loop material. As a user grasps an ear and pulls the ear, elasticity provided about the waist region of the diaper allows the free end to be snugly pulled about the waist of a wearer, and coupled to the diaper. Ears can be rectangular or made of irregular shapes.

The present invention provides a process wherein a rotary knife or die, with one or more cutting edges, turns against and in coordination with a corresponding cylinder to create preferably trapezoidal ears. Ear material is slit into two lanes, one for a left side of a diaper and the other for a right side of a diaper. Fastening tapes are applied to both the right and the left ear webs. The ear material is then die cut with a nested pattern on a synchronized vacuum anvil.

The resulting discrete ear pieces however, due to the trapezoidal pattern of the ears, alternate between a correct orientation and an incorrect (reversed) orientation. The reversed ear is required to be rotated 180° into the correct orientation such that the ears and associated tape present a left ear and a right ear on the diaper.

To accomplish the reversal of the ear pattern, discrete ear pieces are picked up at the nested ear pitch by an ear turner assembly that will expand to a pitch large enough for ears to be unnested and allow clearance for every other ear to be rotated. The rotated ears are then unnested and into the correct orientation.

Two ear turner assemblies can be provided, to rotate every other ear applied to the right side of the product, and every other ear applied to the left side of the product. In this manner, for a single product, one of the two ears will have been rotated 180°.

Ear application to a chassis web can be by a bump method (described later) with intermittent adhesive applied to the chassis web, or can be by vacuum transfer.

The present invention also allows for two side panel assemblies, including fastening mechanisms, to be attached to two ears, the side panel assemblies attached in a pre-folded condition. Two more ears can coupled to a chassis web to create a front panel to wear about the waist of a user.

The present invention also allows for chips of material to be removed from the ears to provide a diaper with contoured leg openings. In one embodiment, the chips may be removed from the ears before the ears are attached to the chassis web. In an additional embodiment the chips may be removed from the ears after the ears are attached to the chassis web. In an additional embodiment the chips may be removed from the ears and a portion of the chassis web removed after the ears are attached to the chassis web.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic side view of a Prior Art process;

FIG. 2 is a top view of a disposable diaper product carrying a pair of ears;

FIG. 3 is a top view of an ear forming web including an individual ear detached from the web;

FIG. 4 is a front view of an anvil roll carrying two ear webs;

FIG. 5 is a schematic view of a nested zero waste back ear applicator device and methods of the present invention;

FIG. 5a is a schematic view of a nested zero waste back ear applicator device and methods of the present invention, with an alternate web path configuration;

FIG. 6 shows an alternate ear pattern and alternate ear sizes;

FIGS. 7A, 7B, 7C, 7D, 7E, and 7F are top views of ear webs, FIG. 7A showing non-rotated alternating die cut ear webs, and FIG. 7B showing alternating rotated die cut ear webs, and FIGS. 7C, 7D, 7E, and 7F showing alternate ear configurations;

FIG. 8 is a perspective schematic view of the nested zero waste back ear applicator device and methods of the present invention;

FIG. 8a is a perspective schematic view of the nested zero waste back ear applicator device and methods of the present invention with an alternate web path configuration;

FIG. 9 is a side view of an ear turner assembly device used to rotate alternating ears;

FIG. 10a is front view of the ear turner assembly device used to rotate alternating ears;

FIG. 10b is front view of the ear turner assembly device used to rotate alternating ears, showing an alternate embodiment of a puck, configured to match in shape and size alternate ear design;

FIG. 11 is a perspective view of two ear turner assembly devices used to rotate alternating ears on a left and a right ear web;

FIG. 12 is a side view of an ear turner assembly device used to rotate alternating ears;

FIG. 13 is a front view two ear turner assembly devices used to rotate alternating ears on a left and a right ear web;

FIG. 14 is a side view of an ear turner assembly device used to rotate alternating ears;

FIG. 15 is a sectional view of the ear turner assembly device used to rotate alternating ears shown in FIG. 10;

FIG. 16 is a front view of an anvil, ultrasonic bonding ring, and vacuum pattern used for pitch changing ears from a slower web and applying and bonding the ears to a faster moving chassis web;

FIG. 17 is a schematic view of the nested zero waste back ear applicator device and methods of the present invention, shown with an alternate embodiment of a means for applying the ear to the chassis web.

FIGS. 18-28 are schematic and plan views of methods of performing nested zero waste back ear application including a multi-component ear portion.

FIG. 18 is a plan view of an ear tab forming material (or wing, nonwoven web);

FIG. 19 is a plan view of an ear tab forming material following slitting and spreading;

FIG. 19a is a schematic view of formation of a side panel assembly;

FIG. 20 is a plan view of a side-panel assembly coupled to the ear tab forming material;

FIG. 21 is a plan view of the side-panel assembly coupled to the ear tab forming material, after the side-panel assembly has been folded;

FIGS. 22 and 23 are a plan view of the side-panel assembly coupled to the ear tab forming material, after the side-panel assembly has been folded, and during and after re-phasing of the side panel and wing assembly;

FIG. 24 is a plan view of the side panel and wing assembly being die cut, re-pitched, and rotated;

FIG. 25 is a plan view of the side panel and wing assembly following cutting, re-pitching and rotation;

FIG. 26 is a plan view of the side panel and wing assembly being coupled to a chassis assembly;

FIG. 27 is a plan view of the side panel and wing assembly, coupled to the chassis assembly, and folded into the profile of the chassis assembly;

FIG. 28 is an in-use plan view of an inventive disposable product formed by the methods of the present invention.

FIGS. 29-42 are schematic and plan views of methods of assembling a disposable product, including forming a nested zero waste ear to a nested zero waste wing portion, attaching ear and wing portions to a chassis top sheet, and folding the product to form a folded diaper.

FIG. 29 is a plan view of an ear tab forming material (or wing, nonwoven web);

FIG. 30 is a plan view of an ear tab forming material following slitting and spreading;

FIGS. 30-32 are a schematic view of formation of an ear assembly being slit, spread, tapes added, and the ear cut, repitched and rotated;

FIGS. 33-34 shown formation of a slit and spread wing web;

FIG. 35 shows the ear bonded to the wing web;

FIG. 36 shows the ear being folded down and temporarily coupled to the wing;

FIGS. 37-38 shown die cutting, repitching and rotating the wing assembly while carrying the ear assembly;

FIG. 39 is a plan view of the side panel and wing assembly being coupled to a chassis assembly;

FIG. 40 is a plan view of the side panel and wing assembly, coupled to the chassis assembly, and folded into the profile of the chassis assembly;

FIG. 41 is an in-use plan view of an inventive disposable product formed by the methods of the present invention;

FIG. 42 is a cross section view of an inventive disposable product formed by the methods of the present invention;

FIGS. 43-60 are schematic and plan views of methods of assembling a disposable product;

FIG. 61 is a plan view of wing assemblies coupled to a chassis assembly with chips removed from the wing assemblies;

FIG. 62 is a plan view of wing assemblies coupled to a chassis assembly with chips removed from the wing assemblies and chassis assembly;

FIG. 63 is a perspective view of a trim removal system of the present invention, with an infeed chassis web, and a chip to be removed therefrom;

FIG. 64 is a two dimensional representation of the trim removal system of FIG. 63;

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FIG. 65 is a cross sectional view of a trim removal system;

FIG. 66 is a schematic view of a trim removal system receiving an article from a transfer roll in an initial chip engaging position;

FIG. 67 is a schematic view of the trim removal system separating a first article from a second article;

FIG. 68 is a schematic view of the trim removal system separating trim from the first article;

FIG. 69 is a schematic view of the trim removal system discharging the trim;

FIG. 70 is a schematic view of the trim removal system returning to its initial chip engaging position;

FIG. 71 is a schematic view of the trim removal system returned to its initial chip engaging position;

FIGS. 72-75 are plan views of the position of the chip relative to the web, demonstrating the ripping effects of the present invention;

FIG. 76 is a plan view of a web of wing assemblies with chips removed from each wing assembly;

FIG. 77 is a plan view of wing assemblies with chips removed from the selected wing assemblies;

FIG. 78 is a plan view of wing assemblies coupled to a chassis assembly with chips removed from the wing assemblies and chassis assembly.

FIG. 79 is a plan view of a product variation showing a slip/cut applied front ear, alternately rotated back ears, and extension panels extending from the back ears;

FIG. 80 is a plan view of a product variation showing a slip/cut applied front ear, alternately rotated back ears, and extension panels extending from the back ears, and a die cut chassis;

FIG. 81 is a plan view of a product variation showing a slip/cut applied front ear, alternately rotated back ears, and extension panels extending from the back ears, die cut front and back ear portions, and a die cut chassis;

FIG. 82 is a plan view of a product variation showing alternately rotated front ears, alternately rotated back ears, and extension panels extending from the back ears;

FIG. 83 is a plan view of a product variation showing alternately rotated front ears, alternately rotated back ears, extension panels extending from the back ears, and a die cut chassis;

FIG. 84 is a plan view of a product variation showing alternately rotated front ears, alternately rotated back ears, extension panels extending from the back ears, a die cut chassis, and die cut ears;

FIG. 85 is a plan view of a product variation showing slip/cut applied front ears, and alternately rotated back ears;

FIG. 86 is a plan view of a product variation showing slip/cut applied front ears, and alternately rotated back ears, and a die cut chassis;

FIG. 87 is a plan view of a product variation showing slip/cut applied front ears, and alternately rotated back ears, a die cut chassis, and die cut ears;

FIG. 88 is a plan view of a product variation showing alternately rotated applied front ears, and alternately rotated back ears;

FIG. 89 is a plan view of a product variation showing alternately rotated applied front ears, and alternately rotated back ears, and a die cut chassis;

FIG. 90 is a plan view of a product variation showing alternately rotated applied front ears, and alternately rotated back ears, a die cut chassis, and die cut ears.

FIG. 91 is a schematic plan view of an extension panel nonwoven web, receiving tapes, which are folded. A stretch laminate web is provided, which receives slit and spread extension panels of the extension panel nonwoven, and the

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combination stretch laminate web, coupled with the extension panels holding folded ears, is itself slit and spread;

FIG. 92 is a side panel nonwoven web with chip portions;

FIG. 93 is the side panel nonwoven web having received (preferably by slip/cut techniques) discrete pieces of the slit and spread combination stretch laminate web, coupled with the extension panels holding folded ears;

FIG. 94 is the side panel nonwoven web having received (preferably by slip/cut techniques) discrete pieces of the slit and spread combination stretch laminate web, coupled with the extension panels holding folded ears, with the discrete pieces of the slit and spread combination stretch laminate web, coupled with the extension panels holding folded ears folded over;

FIG. 95 shows the components of FIG. 94 slit and spread;

FIG. 96 shows the slit and spread components of FIG. 95, with chip removal;

FIG. 97 shows the slit and spread components of FIG. 96 after chip removal, the components spread apart;

FIG. 98 shows the components of FIG. 98 applied to a chassis web;

FIG. 99 shows a plan view of a finished diaper in a laid open position;

FIG. 100 shows an alternate chip pattern for use in the construction of FIGS. 91-99.

FIG. 101 shows an apparatus for placing ears on a chassis web, with zero waste, from a single incoming lane.

FIG. 102 is a side perspective view of the embodiment shown in FIG. 101;

FIG. 103 is a side view of the embodiment shown in FIG. 101.

FIG. 104 are additional symmetrical ear patterns that can be formed with a single incoming web.

FIG. 105 is a schematic of a process of forming and combining extension panels and ears using a dual cut slip unit.

FIG. 106 is a side process view of an apparatus and method of forming and combining extension panels and ears using a dual cut slip unit, and passing the combination to the nested zero waste back ear applicator device, the device having slip cut a first portion from an incoming extension panel web;

FIG. 107 displays a first gap between two successive first portions of the extension panel web.

FIG. 108 is a side process view of the device shown in FIG. 106, with a second cut severing the first portion from an incoming extension panel web into two pieces on a knife anvil roll.

FIG. 109 displays the first gap between two successive first portions of the extension panel web, the discrete portions of the extension panel web being further divided by a second cut prior to being passed to a transfer roll.

FIG. 110 is a side process view of the device shown in FIG. 108, with the two discrete pieces of the incoming extension panel entering into a first ultrasonic bonding unit on a transfer roll, which couples every other discrete piece of the incoming extension panel with a first incoming back ear web; and the remaining discrete piece of the incoming extension panel entering a second ultrasonic bonder along with a second incoming back ear web, with both lanes of formed extension panel/back ear webs exiting, being folded and tack bonded, and passed on to the nested zero waste back ear applicator device.

FIG. 111 displays a first gap between two successive first portions of the extension panel web, along with a second gap

formed between severed portions of the extension panel web following departure from the knife anvil roll and onto the transfer roll.

FIG. 112 is a representation of the pieces which are bonded to the first incoming back ear web by the first ultrasonic bonder, and the pieces which are bonded to the second incoming back ear web by the second ultrasonic bonder, both lanes passed to the nested zero waste back ear applicator device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Although the disclosure hereof is detailed and exact to enable those skilled in the art to practice the invention, the physical embodiments herein disclosed merely exemplify the invention which may be embodied in other specific structures. While the preferred embodiment has been described, the details may be changed without departing from the invention.

Referring to the drawings there is seen in FIG. 1 a diagrammatic illustration of a prior art process for applying tabs to webs in a diaper making process, to result in an intermediate product shown in FIG. 2. The present invention can use this prior art method of affixing the segments 12 to the web 10, with a different anvil, the new anvil 114 described below. Web 10 is a composite material used in formation of diapers which is generally formed of various layers of material such as plastic back sheets, absorbent pads and nonwoven top sheets. A series of ears 12 are applied to web 10. In the illustrated process of FIG. 1, a rotatable vacuum anvil 14 is used to supply the ears 12 to web 10. Anvil 14 has internally reduced air pressure or vacuum (not shown), and a plurality of openings 24 are provided through its surface to enable suction of the tab segments 12 against the anvil surface 14. A web of the ear tab forming material 16 is fed by rollers 20 and 22 against the anvil surface 14 where it is cut into segments by a rotary knife 18.

The surface of the anvil roll 14 can have vacuum holes 24 on its smooth surface. In a typical configuration of a slip-and-cut applicator, there is a pattern of vacuum holes 24 distributed to evenly draw the entering web onto the surface of anvil 14 and thence into the cut point where the knife edge 18 engages the anvil 14.

It can be seen from FIG. 1 that in the prior art, the infeed of the ear tab forming material 16 can be at a first speed (with individual ears 12 spaced together), after which the individual ears gain speed to the speed of the anvil 14. Typical infeed speeds could be 120 mm/product for the infeed, while anvil speeds could be 450 mm/product on the anvil. This transition from the slower first speed to the quicker second speed takes place at the cut point, the ear tab forming material 16 slipping on the anvil 14 until cut. However, immediately at the transition cut point 18 from the slower speed to the faster speed, it is desired to place vacuum on the ears because centrifugal force would try to throw the ears off of the vacuum anvil 14.

Ear webs 16 can be comprised of two portions, 12a and 12b, as shown in FIG. 2. Segment 12a is more specifically referred to as the tab section of the ear 12, segment 12b is the ribbon section of the ear 12.

Alternatively, the ears can comprise a trapezoidal shape, as shown in FIGS. 6, 7A and 7B, which will be described later. The trapezoidal shape of FIGS. 7A and 7B is particularly advantageous for zero waste applications, where it is desired to reduce or eliminate the scrapping of raw material. In another zero waste technique, two parallel series of

alternating ear webs 16 with ribbon sections of the ear 12 could be created by mirroring the web 16 as shown in FIG. 3 and placing the mirrored web down one-half of an ear length (not shown).

Referring now to FIG. 4, a front view of an anvil roll 114 is shown carrying ear forming material 16 (and later, individual ears 12) in phantom. The anvil roll 114 is preferably formed with two vacuum portions 116 separated by a center groove portion 118. The vacuum portions 116 are preferably mirror images of each other. The anvil roll 114 is symmetrical about a center plane through its circumference. Each vacuum portion 116 contains several circumferential rows of circular vacuum holes 24. Each vacuum portion 116 may also contain a circumferential groove 120 with an additional circumferential row of vacuum holes 24 located in the circumferential groove 120.

Still referring to FIG. 4, two diametrically opposed anvil pockets 122 and two diametrically opposed pairs of ear retaining portions 124 are shown. The ear retaining portions can be created as inserts, with different vacuum patterns applied as the user deems necessary. Each anvil pocket 122 is a groove which extends across the face of the entire anvil roll 114.

One ear retaining portion 124 is located on each of the vacuum portions 116. Each ear retaining portion 124 has an ear vacuum hole pattern 126 made of a plurality of vacuum holes 24 located at or near the surface of the anvil roll 114. A plurality of rows of vacuum holes 24 can be employed, each row having a plurality of vacuum holes 24, although more or less than those configurations or patterns shown can be used.

Referring now to FIG. 5, a schematic view of a nested zero waste ear applicator device and methods of the present invention are shown. Components of this ear applicator include a web slitter 210, which processes incoming ear web material 16 into two parallel paths (not shown from this view). After being slit, ear web material is processed by tape applicator 220, which can add tape to the ears for securing the ears 12 about the waist of a wearer.

After slitting and application of the tape to the ear web 16, an ear die is used to cut the ear web 16 into the pattern shown in FIG. 7A. The ear material 16 is die cut with a nested pattern on a synchronized vacuum anvil/die combination 230/232 and carried by rotation or otherwise to an ear turner assembly 200.

Referring still to FIG. 5, the cutting edges of the ear dies 230 turn against and in coordination with a corresponding anvil 232 to create preferably trapezoidal ears. It is noted that as shown in FIG. 6, ears 12 having different heights, H1 and H2, can be produced in this configuration by speeding up or slowing down the infeed rate of material 16 into the anvil/die combination 230/232. In this manner, more or less slip is allowed on material 16 prior to cutting, resulting in longer or shorter ears.

Because the ear material 16 has already been slit into two lanes, one for a left side of a diaper and the other for a right side of a diaper, it is noted that two parallel ear dies 230 are used to produce the pattern shown in FIG. 7A to the slit web 16, but because of the side vantage point of FIG. 5a only one of the lanes is visible if more than one is desired.

The resulting discrete ear pieces however, due to the trapezoidal pattern of the ears shown in FIG. 7A, alternate between a correct orientation A and an incorrect (reversed) orientation B. The reversed ears B are required to be rotated 180° into the correct orientation A such that the ears and associated tape present a left ear and a right ear on the diaper, such as that shown on FIG. 7B. In correct orientation A, such

as shown in FIG. 7B, the shorter of the parallel edges of the trapezoid will face toward an outside, left for the left side, and right for the right side. This geometry is desirable to accommodate the legs of the wearer when the ears 12 are pulled about the waist of the wearer.

To accomplish the reversal of the ear pattern, discrete ear pieces are picked up at the nested ear pitch by an ear turner assembly 200 (see FIGS. 5 and 8) that has a series of pucks 234 that travel radially from a minimal radius R1 (and therefore a minimal tangential speed) to a maximal radius R2 (and therefore a maximal tangential speed) at a depositional site. The difference between R1 and R2 is such that individual pucks 235 can be unnested and allow clearance (in the radial direction from adjacent pucks 234) for every other ear to be rotated, as will be described later in relation to FIGS. 10a and 10b. The rotated ears are then unnested and into the correct orientation and brought to the proper speed for deposition onto either an additional vacuum drum (as shown on FIG. 5a) and subsequently onto web 10 or high vacuum drum 250.

Referring to FIG. 7A, two lanes of ears 12 are depicted, 16A and 16B representing right and left ears intended for a product. The longest side of the ears 12 is intended for attachment to web 10, so because trapezoids are desirable, every other trapezoid in each lane will require 180° rotation to allow the desired side (for example, the longest side) of the ear 12 to be confronted with attachment to web 10. All of the "B" labeled ears 12 on supply 16A will be rotated 180° into an A position. All of the "B" labeled ears 12 on supply 16B will be rotated 180° into an A orientation position to achieve the desired depositional orientation shown in FIG. 7B.

It is noted that ear configurations can vary as shown in FIGS. 7C-7F. In FIGS. 7C and 7D, wavy or curved ear patterns are shown. In FIG. 7E, a square pattern is shown. In FIG. 7F, a trapezoidal pattern is shown. Chips may be cut out in any shape of ear patterns, such as such in FIG. 7F. The chips can be of any shape or size, and can be positioned either on edges of the ears or on the interior of the ears.

Referring now back to FIG. 5, following rotation of every "B" labeled ear 12, each ear is deposited onto vacuum drum 240, rotated and picked up by high vacuum drum 250. Vacuum drum 240 is a size change roll that matches pitch. Vacuum drum 240 can also be used as a roller, in conjunction with or replacing roller 260, FIG. 16.

Because the ears 12 need to be sped up to match the speed of chassis web 10, the rotation of high vacuum drum 250 is quicker than that of vacuum drum 240.

The higher vacuum in drum 250 relative to drum 240 allows the ears 12 to be snatched or grabbed at the higher rotational speed present in drum 250.

Referring now to FIG. 5a, a schematic view of a nested zero waste back ear applicator device and methods of the present invention is shown, with an alternate web path configuration.

Referring now to FIG. 8, a perspective schematic view of the nested zero waste back ear applicator device and methods of the present invention is shown. As can be seen, two ear turner assemblies 200R (right) and 200L (left) are provided, to rotate every other ear 12 applied to the right side of the chassis web 10, and every other ear 12 applied to the left side of the chassis web 10. In this manner, for a single product, one of the two ears will have been rotated 180°.

As can be seen from FIG. 8, two types of pucks are provided, non-rotating pucks 234A and rotating pucks 234B. The non-rotating pucks 234A carry the "A" ears shown in FIG. 7A, or the ones that do not require rotation. The

rotating pucks 234B carry the "B" ears shown in FIG. 7A. As the ear turner assemblies 200R and 200L go through their rotation, ears 12 are picked up from the ear die/anvil station 230/232 and rotate about the rotator 200, while every rotating puck 234B also rotates radially during rotation of the rotator 200, as will be described later.

The ears 12 are then deposited onto chassis web 10 and bonded thereto, for instance by ultrasonic bonding ring 252, where the resulting product is sent downstream for further processing.

Referring now to FIG. 8a, a perspective schematic view of the nested zero waste back ear applicator device and methods of the present invention with an alternate web path configuration is shown. This is the preferred embodiment of the vacuum drum/ultrasonic bonding ring 250/252 in relation to the vacuum drum 240. In this configuration, the ears are ultrasonically bonded to the chassis web 10 between the vacuum drum/ultrasonic bonding ring 250/252 and the vacuum drum 240 as the chassis web 10 travels from right to left as pictured.

Referring now to FIG. 9 a side view of the ear turner assembly device 200 is shown. The ear turner assembly device 200 used to rotate alternating ears, again with the entire device 200, rotating about a central axis, and each puck 234 traveling radially from a minimal radius R1 to a maximal radius R2 at a depositional site during rotation, and then back to the minimal radius R1. The difference between R1 and R2 is such that individual pucks 235 can be unnested and allow clearance for every other ear to be rotated. Comparing the During rotation from the R1 to the R2 position, rotating pucks 234B undergo not only the increase in radius, but also undergo 180° rotation about an axis perpendicular to the central axis. This can be performed preferably with a screw operation (reference letter S, FIG. 12). During rotation from the R2 position back to the R1 position, the rotating pucks 234B rotate back through their 180° rotation to get to their initial position by use of a yankee screw, which is capable of both advancing and retracting the pucks 234B, and rotating the pucks 234B, upon driving the shaft of the yankee screw inward and outward radially.

Referring now to FIG. 10a, a front view of the ear turner assembly device 200 used to rotate alternating ears is shown. As can be seen, the pucks 234 are each equipped with vacuum voids 236 through which a vacuum is pulled, retaining ears on the rotator device 200 through their rotation (radially rotating for every ear, radially and axially rotating for every other ear) until deposition. As can be seen, the pucks 234 are can be roughly trapezoidal in shape to roughly match the shape of the ears 12. It is also seen from this view that the non-rotating pucks 234A remain in their axial non-rotated position relative to the rotating pucks 234B, which rotate from their initial position nested between two non-rotating pucks 234A, and back.

Referring now to FIG. 10B, an alternate shape of the pucks 234 is shown. In FIG. 10A, the pucks 234 are configured to receive wavy shaped ears as described earlier. In FIG. 10B, the pucks 234 are configured to receive trapezoidal shaped ears as described earlier. It is preferable to configure the pucks 234 to match the desired ear pattern.

Referring now to FIG. 11, a perspective view of the two ear turner assembly devices 200R and 200L are shown. Also shown are vacuum manifolds used to apply the vacuum to the pucks 234. In this sense, the rotation of the pucks 234 is described in currently pending U.S. application Ser. No.

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11/244,387, which is incorporated herein by reference. A front view of this configuration is shown in FIG. 13 and a side view in FIG. 14.

Referring now to FIG. 12 a mechanism for rotating pucks 234b is shown. There, it is seen that screws 236 are provided such that movement of the pucks 234B away from the center axis simultaneously causes rotation of puck 234B. A radially traveling coupling 238 couples the puck with the screw 236, and when the threads of the screw are engaged with the radially traveling coupling 238, rotation is caused.

FIG. 15 is a cross-sectional view of the ear turner assembly device 200 used to rotate alternating ears along the line shown in FIG. 12. Particularly, screws 236 are operably coupled with pucks or rotator assemblies 234. By rotation of the screw 236, pucks 234 are moved along a radial line in relation to shaft turner 246. Vacuum manifold 244 is provided to commute vacuum to the pucks 234 and ultimately to hold the ears 12 in place. Ear turner cam 242 is provided for rotative purposes.

Referring now to FIG. 16, a front view of a rotatable vacuum wheel 114, ultrasonic bonding ring 252, and vacuum pattern 124 used for pitch changing ears from a slower web and applying and bonding the ears 12 sandwiched between roller 260 and the anvil 114 to a faster moving chassis web is shown.

In this embodiment, the aggressive vacuum pattern 124 on high vacuum drum 250 will have withdrawn ears 12 from vacuum drum 240. This step follows the rotation of the "B" ears as described above. The chassis web 10 is fed in between the roller 260 and the high vacuum drum 250. The ultrasonic bonding ring 252 couples the ears 12 with the chassis web 10 (refer to FIG. 5).

Referring now to FIG. 17, a schematic view of the nested zero waste back ear applicator device 200 an alternate embodiment of a means for applying the ear 12 to the chassis web 10 is shown. Instead of the vacuum porting system as previously described, a protuberance carrying rotatable body 274 is urged against the chassis web 10, as disclosed in U.S. Pat. No. 6,475,325, which is incorporated herein as if fully set forth. The disclosure of U.S. Pat. No. 6,475,325 is referred to as the "bump transfer" method. In this embodiment intermittent adhesive is applied to the chassis web 10 at station 270. The intermittent adhesive is applied at intervals to make contact with ears 12 carried by rotating body 200. The protuberance carried by body 274 urges the chassis web 10 towards an ear 12 carried by a puck 234. With the ear 12 coupled with the chassis web, the coupled material is processed by final bonding station 272, after which the ear/chassis combination is sent downstream for further processing as desired.

Referring generally to FIGS. 18-28, schematic and plan views are presented of a novel disposable garment configuration using methods of performing nested zero waste back ear application including a multi-component ear portion fabrication, bonding and folding. The embodiments of FIGS. 18-28 are particularly well suited for formation of what is called in the industry as an adult-sized diaper.

One difficulty with adult-sized products is sheer size. The products are required to be quite large (for instance, 32" wide in a non-stretched condition) in the waist section to fit about the waist of an adult. However, the adult-sized products are typically shipped in packages about 8" wide, so the products require folding, particularly at the waist zone where the product is the widest, in order to be compactly packaged and shipped.

The prior art often employed a Z-fold of ears to get the waist band down to size. For instance, the ears 12 applied to

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web 10 shown in FIG. 2 would have to be folded as to not extend much past the profile of the chassis web 10. This assists both processing of the web as it avoids flying parts, but also assists packaging and transport of the material.

The embodiments of FIGS. 18-28 show construction of an ear segment that can be formed of multiple pieces, as opposed to the one piece ears of the prior art (see, e.g., ears 12 of FIG. 2). This allows both creation of a contoured multi-piece ear segment, as well as assembly of at least portions of the ear segment in a pre-folded condition.

Referring now to FIG. 18, a plan view of an ear tab forming material 316 is shown entering the system similarly positioned to material 16 shown on FIG. 8 or 8a. Preferably the ear tab forming material (or wing) 116 is a non-woven continuous web of material which is ultimately formed into shaped ear portions 312. Shaped ear portions 312, as described with respect to FIGS. 7a-7f, can take on different shapes, and can have correct original orientation, or orientation that requires re-phasing or turning as described above.

In a preferred embodiment ear portions 312 of the present invention will have side panel assembly receiving ear portion configurations 312a and 312d, and non-receiving ear portion configurations 312b and 312c as will be described later.

Referring to FIG. 19, the ear tab forming material 316 is slit and spread, for instance as shown on FIG. 8 at station 210. Lanes 316a and 316b of slit and spread ear tab forming material 316 receive the side panel assemblies described in FIG. 19a, and ultimately become left and right ear segments on a disposable product.

Referring now to FIG. 19a, a schematic view of formation of side panel assemblies 320 is shown. The formation of side panel assemblies 320 begins with an outer non-woven web material 318, which is slit and spread into discrete non-woven web portions 318a, 318b, 318c, and 318d, each of the non-woven web portions also preferably being cut in the cross-machine direction into the preferred size.

To each of the discrete non-woven web portions 318a, 318b, 318c, and 318d, one or more fastening mechanisms 322 are applied. Fastening mechanisms 322 can be tape tabs, covered tape tabs, strips of hook and loop material, continuous hook and loop material, patches of hook and loop material, etc. The fastening mechanisms 322 will be unfastened and refastened about the waist of the user to tighten the disposable garment about the waist.

Next, the non-woven webs 318 carrying fastening mechanisms 322 are folded over, creating a folded web 318 and folded fastening mechanisms 322'.

This causes the combination of the non-woven web 318 and the fastening mechanisms 322 to be narrower than the discrete non-woven web portions 318a, 318b, 318c, and 318d. It is noted that the folded fastening mechanisms 322' of web portions 318a and 318b will have opposing fastening mechanisms 322' as they will become the right and left hip waist fastening mechanisms, respectively, once placed about the waist of a user (shown later in the process).

In addition to the discrete non-woven web portions 318a, 318b, 318c, and 318d, a stretch laminate web 324 is also provided. This too is slit and spread into discrete stretch laminate web portions 324a, 324b, 324c, and 324d.

Next, the non-woven web portions 318a, 318b, 318c, and 318d, including their respective fastening mechanisms 322', are bonded to stretch laminate web portions 324a, 324b, 324c, and 324d respectively, forming the side panel assemblies 320 in four different lanes, 318a+324a, 318b+324b, 318c+324c, and 318d+324d. The non-woven web portions 318a, 318b, 318c, and 318d can be bonded to the stretch

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laminate web portions **324a**, **324b**, **324c**, and **324d** in any fashion, such as by ultrasonic bonding using a mechanism such as shown in FIG. 16, by lap seams, by adhesives, fin seams, etc.

The stretch laminate portions **324a**, **324b**, **324c**, and **324d** can also be folded if desired, or the stretch laminate portions **324a**, **324b**, **324c**, and **324d** in combination with the non-woven web portions **318a**, **318b**, **318c**, and **318d** can all be folded together and again.

Referring now to FIG. 20, a plan view of a side-panel assembly **320** coupled to the ear tab forming material is shown. In a preferred embodiment, side-panel assembly **320**, and particularly the panel **320** having configuration **318a+324a** (from FIG. 19), is slip-cut onto the top of lane **316a**, and particularly slip-cut and coupled to ear portion configuration **312a**.

Similarly, side-panel assembly **320**, and particularly the panel **320** having configuration **318b+324b** (from FIG. 19), is slip-cut onto the bottom of lane **316a**, and particularly slip-cut and coupled to ear portion configuration **312d**.

In lane **316b**, side-panel assembly **320**, and particularly the panel **320** having configuration **318c+324c** (from FIG. 19), is slip-cut onto the top of lane **316b**, and particularly slip-cut and coupled to ear portion configuration **312c**.

Similarly, side-panel assembly **320**, and particularly the panel **320** having configuration **318d+324d** (from FIG. 19), is slip-cut onto the bottom of lane **316b**, and particularly slip-cut and coupled to ear portion configuration **312a**.

The panels **320** can be coupled to the slit and spread ear tab forming material **316** in any fashion. Preferred methods may include ultrasonic bonding, adhesive bonding, heat, etc. Also, the coupling between the panels **320** and the ear tab forming material **316** could be contained in, or be a portion of a larger laminate involving other materials and bonds.

Next, referring now to FIG. 21, the side-panel assemblies **320** have been folded over (or under) the ear tab forming material **316**, to conform to, and preferably be narrower than, the ear portions **312** of lanes **316a** and **316**.

It is desirable to process the combination of the side-panel assemblies **320** temporarily staked to the ear tab forming material **316** together, so that components do not become entangled in the machinery during processing. It is also desirable so that packaging can be accomplished orderly and uniformly. Preferably, the side-panel assemblies **320** are temporarily staked to the ear tab forming material **316**. The temporary staking can be done, for instance but not by way of limitation, by a light application of adhesive, by a light compression bond, by a light compression bond assisted by slight penetration of pins through the layers, by a weak ultrasonic bond, or by other types of temporary and light bonds may be employed.

Referring now to FIGS. 22-25, after the side-panel assembly **320** has been coupled to the ear tab forming material **316**, and after the side-panel assembly **320** has been folded, the side panel and wing assembly **320+316** is treated as the ear **12** was treated with reference to FIGS. 1-17. For instance, the side panel assembly **320** and ear tab **316** can be re-phased (FIGS. 22-23), then die-cut, repitched, and rotated (FIGS. 24-25).

In particular, the ear portion configurations **312c** and **312d** can be slip-cut together with a unit such as shown on FIG. 8 or **8a** onto the machine shown on FIG. 9, which would die-cut, re-pitch and rotate every other wing assembly as shown on FIG. 24.

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The **316a** lane would be treated by one of the ear turner assemblies **200R** (right) or **200L** (left) of FIG. 11, and the **316b** lane would be treated by the other of the **200R** or **200L** ear turner assemblies.

As a result, and as shown on FIG. 25, every other of the ear portion configurations **312c** and **312d** will have been rotated 180° and re-phased, such that the **312a/312b** ear portion configurations will appear identical to the rotated **312c/312d** ear portion configurations and the **316a** and **316b** lanes would be mirror images of one another.

Referring now to FIG. 26, the ears **312** and side panels **320** have been properly oriented and re-phased such that right front ear **312b** (front of product, no side panel **320** attached) and its associated right back ear **312d** (back of product, with a side panel **320** attached and folded) are mirrored with left front ear **312c** (front of product, no side panel **320** attached) and its associated left back ear **312d** (back of product, with a side panel **320** attached and folded). These ears **312** and side panels **320** are introduced to, and coupled with web **10** (or chassis top sheet), typically a composite material used in formation of diapers which is generally formed of various layers of material such as plastic back sheets, absorbent pads **340** and nonwoven top sheets (visible in FIGS. 27 and 28).

Referring now to FIG. 27, the next step is to fold the ears **312b** and **312c**, and **312a** and **312d** their associated side panels **320** down, in overlapping fashion, such that either one of lanes **316a** and **316b** is folded down first, followed by the other. As can be seen, the ears **312b** and **312c**, and **312a** and **312d** their associated side panels **320** are folded into, and narrower than, the width of the chassis assembly **10** in the cross-machine direction.

FIG. 28 is an in-use plan view of a inventive disposable product formed by the methods of the present invention. As can be seen, the ears **312a** and **312d** are coupled to their associated side panels **320**, which had been previously folded onto the ears **312**. A user can place the absorbent pad **340** in the crotch region, and couple the fastening mechanisms **322** of the side panels **320** about the waist, to reach the front of ears **312b** and **312c** and fasten the disposable product.

Referring now to FIGS. 29-42, schematic and plan views of methods of assembling a disposable product, including forming a nested zero waste ear to a nested zero waste wing portion, attaching ear and wing portions to a chassis top sheet, and folding the product to form a folded diaper are shown. In general, the product shown in FIGS. 29-42 is formed by cutting (preferably die cutting) a web (preferably a stretch laminate or non-woven) to form an ear, alternately turning and attaching the ear to a wing, fold and stack the ear to the wing, die cutting the wing, alternately turning and attaching wing and ear assembly to a chassis, folding and stacking a wing to a chassis non-woven.

Referring to FIG. 29, the process begins with a web portion **1000** (preferably non-woven), introduced into the system, which, as shown in FIG. 30, is split and spread into four lanes of non-woven webs **1002**, **1004**, **1006**, and **1008**, similar to that described above with reference to FIG. 19a. Instead of the rectangular cuts created of the discrete non-woven web portions **318a**, **318b**, **318c**, and **318d** of FIG. 19a, the ears **1012** shown in formation of the ear of FIGS. 29-32 can be cut of a zero waste trapezoidal configuration as shown, or other zero waste rectangular or non-rectangular configurations (such as in FIGS. 7a-7f).

As shown in FIG. 31, tapes **1022** are applied to the non-woven (similar to **322** and **322'** of FIG. 19a) and folded. Next, referring to FIG. 32 the ears **1012** are die cut, repitched

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and rotated, in the fashion shown, for instance utilizing a machine depicted in FIGS. 11-14. The final orientations shown tapes 1022 folded in-line of the ears 1012, and the ear orientations after folding resulting in four different ear orientations, 1012a, 1012b, 1012c, and 1012d.

In orientation 1012a, the tapes 1022 are on the top side, with the long side (opposite the top side) on the bottom side. In orientation 1012b, the tapes 1022 are on the bottom side, with the long side (opposite the bottom side) on the top side. Similar rotation and resulting orientations are shown with respect to 1012c and 1012d.

Referring to FIGS. 33 and 34, a wing web 1040, preferably non-woven for receiving folded tapes 1022 coupled to ears 1012 is shown, with wing web 1040 slit and spread such as in FIGS. 18 and 19, and the ear after cutting, repitching and rotation, is introduced to the wing web as shown in FIG. 35 (similar to FIG. 20 above).

As can be seen in FIG. 35, the folded tapes 1022 coupled to ears 1012 are introduced in the fashion shown, with the 1042 lane of wing web material receiving folded tapes 1022 coupled to ears 1012 in orientation 1012a coupled to a wing web portion 1042b, such that the short edge of the trapezoid in the cross-machine direction (left to right) receives the long edge of the ears 1012 from the 1012a orientation. The short edge of wing web portions 1042a in the cross-machine direction receives the long edge of ear 1012 in the 1012b orientation. The configuration that results is pictured in FIG. 35, also regarding lane 1044 of wing web material with the short portions of portions 1040a in the cross-machine direction receiving ears 1012 in the 1012c orientation on the long side of the 1012c orientation in the cross-machine direction, and similarly with portions 1044b receiving 1012d oriented ears 1012d as shown.

All of the ears are then folded down as shown in FIG. 36, such that portions 1042a and 1042b host ears 1012, while portions 1042c and 1042d do not host ears. Portions 1044a and 1044b host ear portions 1012 oriented in the 1012c and 1012d orientations, respectively. In FIGS. 36-40, the process continues as shown, similar to the process described above in relation to FIGS. 21-27. A representative product as shown in FIG. 41 is formed thereby, its cross section shown in FIG. 42.

Referring to FIG. 37, it is seen that every other of the pair of elements from the 1042 lane are rotated. The 1042d and adjacent 1042a elements are not rotated, while the 1042b and adjacent 1044c are rotated 180° into sequence. Similarly with respect to lane 1044, elements 1044c and 1044b are rotated into sequence while elements 1044a and 1044d are not rotated in orientation relative to the machine direction.

What can be seen in FIG. 38 is that the elements have been positioned properly to be deposited onto a chassis web (preferably pre-formed with the elements such as an absorbent core, top sheet and back sheet as shown, but not labeled in the remaining figures). All of the folding of the ear portions 1012 on the wing portions 104s are to the top of lane 1042 and the bottom of lane 1044, so that when a chassis portion is coupled between lanes 1042 and 1044 as shown in FIG. 39, the wings 1042a carrying ears 1012d and 1044a can form two waist-wrapping portions. The space between elements 1042a and 1042c will form left leg portions and the space between elements 1044a and 1044c will form right leg portions.

Referring now to FIG. 40, the elements 1042a (carrying ear 1012a), 1042b (carrying ear 1012b), 1042c and 1042d, as well as 1044a (carrying ear 1012d), 1044b (carrying ear 1012c), 1044c and 1044d are folded over to be in-line with the chassis web 10.

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Referring now to FIGS. 43-60, and additional embodiment is formed using the procedure shown therein.

Referring to FIG. 43, a laminate is shown after slit stretching (501-504), and four lanes of hook material 505 are shown below. In FIG. 44, the hooks 505 are shown attached to the stretch laminate webs 501-504, while additional slit outer non-woven web 510 and 512 is introduced, and as shown in FIG. 45, the stretch laminate webs 501-504 are coupled to outer non-woven webs 510 and 512 as shown, for instance by ultrasonic bond methods.

Next, as shown in FIG. 46, the side panel laminate is folded as shown. The side panel laminate is slit as shown in FIG. 47, forming side panel assemblies 501/501a, 502/501b, 503/501c, and 504/501d respectively. Next, the back ear web 610a, 610b (preferably non-woven) as shown being formed in FIG. 51 and slit in FIG. 52, are introduced, preferably in slip/cut fashion to and coupled with the side panel assemblies 501/501a, 502/501b, 503/501c, and 504/501d as shown in FIG. 48.

The side panel assemblies 501/501a, 502/501b, 503/501c, and 504/501d are then folded and preferably temporarily staked together as shown in FIG. 49.

Next, the side panel assemblies side panel assemblies 501/510a, 502/510b, 503/510c, and 504/510d coupled with respective back ear web portions 610a1, 610a2, 610a3, and 610a4, and 610b1, 610b2, 610b3, and 610b4 are die cut, repitched and rotated according to FIGS. 50a to result in the end orientation shown in FIG. 50b, wherein every other of 610a1, 610a2, 610a3, and 610a4 has been rotated 180 degrees, and every other of 610b1, 610b2, 610b3, and 610b4 has also been rotated 180 degrees and rephrased to result in the matched folded right and left sets.

The front ear non-woven web 702/704, and particularly portions 702a, 702b, 702c, and 702d, and 704a, 704b, 704c, and 704d are shown being formed and slit in FIGS. 53 and 54, and then die cut, repitched, and rotated as shown in FIGS. 55-56.

As shown in FIG. 57, the front ear non-woven portions 702a, 702b, 702c, and 702d, and 704a, 704b, 704c, and 704d are introduced to and coupled about opposite sides of the chassis web 10, and the respective back ear web portions 610a1, 610a2, 610a3, and 610a4, having been properly aligned, as well as respective back ear web portions 610b1, 610b2, 610b3, and 610b4 also having been properly aligned, are likewise introduced to and coupled about opposite sides of the chassis web 10 as shown in FIG. 58, positioned alternating with front ear portions as shown.

The front ear portions 702a, 702b, 702c, and 702d, and 704a, 704b, 704c, and 704d; and the back ear web portions 610a1, 610a2, 610a3, and 610a4; and 610b1, 610b2, 610b3, and 610b4; are all folded to conform with (slightly greater than, equal to, or slightly less than) the cross-machine directional width of the chassis 10 as shown in FIG. 59.

A product is formed having the configuration shown in FIG. 60.

It is contemplated that it may be desirable to provide a disposable product with a contoured or curved leg opening 1200 by trimming a portion of a combined web 1202 after wings 1042a-1042d, 1044a-1044d have been placed on the chassis web 10 as shown in FIGS. 61 and 62. For illustrative purposes, the combined web 1202 and resulting disposable garment 1204 of FIGS. 39-41 are shown in FIGS. 61 and 62, however, it should be understood that the methods described herein may be utilized on any combined web. Preferably, the combined web 1202 includes a chassis web 10, a plurality of

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ear carrying wings **1042a**, **1042b**, **1044a**, **1044b** and non-ear carrying wings **1042c**, **1042d**, **1044c**, **1044d** as shown in FIG. 39.

Preferably, a portion of the ear carrying wings **1042a**, **1042b**, **1044a**, **1044b** and the non-ear carrying wings **1042c**, **1042d**, **1044c**, **1044d** on each side of the garment **1204** may be removed to create a contoured shape, as shown in FIG. 61. However, it is also contemplated that a portion of the chassis web **10** between the ear carrying wing **1042a**, **1042b**, **1044a**, **1044b** and non-ear carrying wing **1042c**, **1042d**, **1044c**, **1044d** may also be removed to create a contoured shape as shown in FIG. 62. For example, as shown in FIG. 61, a portion of the chassis web between a first non-ear carrying wing portion **1042d** and a first ear carrying wing portion **1042b** has been removed.

It is contemplated that any means known in the art may be utilized to remove the desired portions of the wings **1042a**–**1042d**, **1044a**–**1044d** and, if desired, chassis web **10**, to create the contoured leg opening **1200**. For example, and not by way of limitation, a knife roll may be utilized to cut the garment leg opening **1200** to the desired contour. In such a system, a contoured knife roll, with a cutting edge sized and configured to cut the leg opening **1200** to the desired shape would be provided.

It is contemplated that both the left **1200a** and the right **1200b** leg opening could be cut at the same time for example with a knife roll with two cutting surfaces, or that a pair of knife rolls, one for the left leg opening **1200a** and one for the right leg opening **1200b** may be utilized. Each knife roll is provided with an associated anvil, as is well known in the art. In use, the anvil and the knife roll each rotate, with the combined web **1202** to be cut between the surface of the knife roll and the anvil. As the knife roll rotates, the cutting edge cuts the combined web **1202** against the anvil.

It is further contemplated that a trim removal system **1210** such as shown in FIG. 63 may be utilized to remove the cut chips from the combined web **1202**. FIG. 63 shows an infeed web **1202**, and a chip or chips **1230** to be removed therefrom. A transfer roll **1214** and an associated trim shoe or trim shoes **1212** are provided to engage the combined web **1202** and chips **1230**. Preferably, the trim shoes **1212** are shaped complimentary with the chips **1230**. Vacuum ports **1216** are provided on the transfer roll **1214** and trim shoes **1212** for maintaining the combined web **1202** and chips **1230** in close contact with the transfer roll **1214** and trim shoes **1212**. It is noted that other methods of cutting the web, in addition to the particular trim removal system **1210** may be used to form the products of the present invention. It is also noted that the chip removal system **1210** as pictured, is configured to cut two chips **1230** from the incoming web **1202** at outboard portions of the incoming web **1202**. Different shoe **1212** configurations can be used to cut different sized and/or shaped chips **1230**, such as the chips **1230** desired to be removed from successive back ears **1042a** and **1042b** as shown in FIG. 76, or chips **1230** from between successive front ears **1042c** and **1042d** as shown in FIG. 76 if desired. Compare FIGS. 76 showing chips removed between successive front ears **1042c** and **1042d**, and FIG. 77, with no chips between front between front ears **1042c** and **1042d**.

An inner axle **1218** and an outer axle **1220** are coupled to the transfer roll **1214** (or hub **1222**) and the trim shoes **1212**, respectively. The inner axle **1218** and the outer axle **1220** are capable of being operated at different speeds in relation to one another by servo motor (not shown). This difference in speed allows the trim shoes **1212** to rotate faster or slower with respect to the transfer roll **1214** as desired. In use, as will be described later, this speed differential creates a

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ripping effect by first pulling the combined web **1202** away from the chip **30** as the transfer roll **1214** is rotating faster than the shoe **1212**, then by pulling the chip **1230** away from the combined web **1202** as the shoe **1212** is rotating faster than the transfer roll **1214**.

Referring now to FIG. 64, a two dimensional representation of the trim shoe **1212** and transfer roll **1214** of FIG. 63 is shown. As can be seen, vacuum channels **1217** communicate with vacuum ports **1216** on both the trim shoe **1212** and transfer roll **1214** to maintain control of the chip **1230** and combined web **1202**. From this perspective, it can be seen that different rotational speeds of the trim shoe **1212** and transfer roll **1214** will cause a ripping effect by first pulling the web **1202** away from the chip **1230** as the transfer roll **1214** is rotating faster than the shoe **1212**, then by pulling the chip **1230** away from the combined web **1202** as the shoe **1212** is rotating faster than the transfer roll **1214**.

FIG. 65 is a cross sectional view of a trim shoe **1212** and transfer roll **1214** of the present invention. As can be seen, vacuum is communicated to ports **1216** through channels **1217**, which are coupled to a source of vacuum (not shown). Rotation of the outer axle **1220**, which is coupled to the shoe **1212**, causes rotation of the shoe **1212**. The inner axle **1218** is coupled preferably to hub **1222** and to transfer roll **1214**.

Referring now to FIGS. 66–71, a sequence is shown of the trim removal system **1210** removing chips **1230** and discharging them, and then the system **1210** returning to its initial position to remove more chips **1230** from the next segment of web **1202**. FIGS. 72–75 are plan views of the position of the chips **1230** relative to the web **1202** at the positions associated with FIGS. 66–68 respectively, demonstrating the ripping effects of the present invention.

Referring now to FIG. 66, a schematic view of the system **1210** is shown receiving an infeed web **1202**. In this figure, die and anvil system **1226** is shown rotating to engage the web **1202** and cut from it chips **1230** (not apparent in this view), as is well known in the art. Unfortunately, the die of the die and anvil system **1226** is susceptible to wear and tear and requires replacement once the die dulls to an unacceptable condition.

In this view, the trim shoe **1212** can be seen in an initial chip engaging position, aligned to receive the chip **1230** of the web **1202** onto the shoe **1212**, which, as described previously, will be urged against the surface of the shoe **1212** by vacuum ports **1216**. The trim shoe **1212** will be seen to be rotating about outer axis **1220**. In this view, a discharge chute **1228** is shown for ultimately receiving waste chips **1230**, and an outfeed conveyor **1240** is provided for receiving the web **1202** with the chip **1230** removed, for further processing and manufacturing steps in the composition of the disposable garments, as desired.

Inner axle **1218** is preferably operated at a first continuous speed, rotating hub **1222** and transfer roll **1214** at a continuous speed, consistent with the infeed speed of the web **1202**. At this initial chip engaging position shown in FIG. 66, the outer axle **1220**, and associated shoes **1212**, are rotated at the same speed as the inner axle **1218**.

The position of the chip **1230** relative to the web **1202** is shown in FIG. 72 for the initial chip engaging position. In this position, the anvil and die **1226** has created a sever, but the chip **1230** and web **1202** could remain somewhat coupled depending on the sharpness of the die **1226**. The severing method shown in the figures, particularly the severing trim removal device **1210** is just one method of forming the novel products of the present invention, other methods of severing and/or trim removal may be used.

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Referring now to FIG. 67, the outer axle 1220, and associated shoes 1212, are toggled slower than inner axle 1218 to allow the web 1202 to be ripped from the chip 1230 at the leading edge of the chip 1230 in the machine direction. It is apparent in this view that the distance between the trailing edge of the shoes 1212 has become closer to the leading edge of the transfer roll 1214. This ripping is caused by the main web 1202 being ripped away from the chip 1230 at the leading edge of the chip 1230 as is shown in associated FIG. 73.

Referring now to FIG. 68, the outer axle 1220 is toggled equal to and then faster than the inner axle 1218, to allow the chips 1230 to rip from the web 1202 at the trailing edge of the chips 30 as is shown in associated FIG. 74. At this point in the process, the chip 1230 will be removed from the web 1202 by ripping first the main web 1202 away from the chip 1230 at the leading edge of the chip 1230, and next by ripping the trailing edge of the chip 1230 from the web 1202.

The outfeed conveyor 1240 is provided for receiving the web 1202 with the chip 1230 removed as shown in FIG. 75, for further processing and manufacturing steps in the composition of the disposable garments, as desired. The vacuum of the transfer roll 1214 can be turned off at this point to allow for release of the web 1202 to the conveyor, for instance in accordance with application Ser. No. 11/141,552, entitled "High Speed Vacuum Porting" which is incorporated herein by reference.

Referring now to FIG. 69, the chip 1230 is discharged into a discharge chute 1228, which is preferably vacuum assisted, although other collection means would satisfactorily accomplish the function of collecting waste chips 1230. It is noted that vacuum is allowed to turn off of the shoes 1212 to allow the chips 1230 to release into the chute 1228. Alternatively a vacuum in the chute 1228 could simply be provided that is stronger than the vacuum applied to the shoes 1212.

The rotational speed of the shoes 1212 and outer axle 1220, which were first operated at a speed roughly equal to inner axle 1218, rotating hub 1222 and transfer roll 1214, initially decreased, or lagged as is shown by comparing FIG. 66 with FIG. 67.

Next, the rotational speed of the shoes 1212 and outer axle 1220, increased, or surged relative to the inner axle 1218, rotating hub 1222 and transfer roll 1214.

In order to return to the initial chip engaging position, the rotational speed of the shoes 1212 and outer axle 1220, must again decrease, or lag relative to the inner axle 1218, rotating hub 1222 and transfer roll 1214. This lag is apparent by comparing FIG. 68 to FIGS. 69, 70 and 71. Finally, in FIG. 71, through one revolution, the system 1210 has removed and discharged the chips 1230, discharged the web 1202 for further processing, and the shoes 1212 have been returned to their initial position to remove more chips 1230 from the next segment of web 1202.

It is contemplated that the die of the die and anvil system 1226 in the above described trim removal apparatus may be replaced by a perforating apparatus. The perforating apparatus preferably forms the chips 1230 on the web 1202, but does not completely sever the chips 1230 from the web 1202. The perforated chips 1230 perforated could then be removed from the web 1202 in the same manner described above. The perforating apparatus may take any form known in the art including, but not limited to, a perforating die roll.

It is further contemplated that the chips may be removed from the wings 1042a-1042d, 1044a-1044d prior to attaching the wings 1042a-1042d, 1044a-1044d to the chassis web 10. The chips may be removed from the wings 1042a-1042d,

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1044a-1044d, using any means known in the art. For example, the wing web 1042, 1044 may be fed between an anvil and knife roll, the knife roll having a cutting edge sized and configured to cut the desired chips from the wings 1042a-1042d, 1044a-1044d.

Although the illustrated embodiments of FIGS. 61, 62 and 76 show a particular configuration or shape of chip being removed from the wings 1042a-1042d, 1044a-1044d and web 10, is contemplated that the chips removed from the wings 1042a-1042d, 1044a-1044d could take any desired shapes to provide a contoured leg opening 1200.

It is further contemplated that, if desired, chips could be removed from only the ear carrying wings 1042a, 1042b, 1044a, 1044b or the non-ear carrying wings 1042c, 1042d, 1044c, 1044d. For example, FIG. 77 shows a chip removed from only the ear carrying wings 1042a, 1042b, 1044a, 1044b. The chips may be cut from the desired wings 1042a-1042d, 1044a-1044d using any means known in the art, including those means described above.

It is further contemplated that chips may be removed from the wings 1042a-1042d, 1044a-1044d and the chassis 10 in separate steps as shown in FIG. 78. For example, chips may be cut from the wings 1042a-1042d, 1044a-1044d in a first step and then cut from the web 10 in a second step, or vice versa. The chips may be cut from the wings 1042a-1042d, 1044a-1044d and web 10 using any means known in the art, including those means described above.

Referring now to FIGS. 79-90, using the principles of the present invention, several product configuration variations are shown. For instance, it is possible to pre-apply either front 1042 (c or d) or 1044 (c or d) or back 1042 (a or b) or 1044 (a or b) ears to a chassis web using previously known slip/cut techniques (e.g., the slip/cut applied ears 1144 shown in FIG. 79), and then use the alternate rotation technique of the present invention to assemble a novel product configuration (see., e.g., FIG. 79). Similarly, it is possible to post-apply either front or back ears to a chassis web using previously known slip/cut techniques, after using the alternate rotation technique of the present invention to assemble a novel product configuration, resulting in a configuration such as FIG. 79. In this method, the slip/cut technique is used to, for instance, apply each front ear 1144 (both left and right front ears 1144, FIG. 79), and the alternating rotation technique described previously is used to apply each back ear portion (e.g., 1042b and 1044b, FIG. 79).

Additionally, it is seen that extension panels 1012 can be applied or not, if desired (compare FIG. 79 with extension panels 1012 and FIG. 85, without extension panels 1012) to the back ear portions 1044 if desired, and that those extension panels 1012 can be paired with the back ears 1044 with the extension panels 1012 in pre-folded (or unfolded) condition if desired (e.g., shown unfolded, with fold lines, on FIG. 79). Additionally, front ear portions 1144 can arrive at the chassis web in a pre-folded condition (e.g., shown unfolded, with fold lines, on FIG. 79), if a wider front ear portion 1144 is desired. These configurations can also be combined with the chip removal technique previously discussed (or any other chip removal or die cutting or ear web formation technique), in which curved portions of either one or both ears 1144, 1044, or 1042, or a leg portion 1200a and 1200b of the chassis, or any combination of the foregoing (see, e.g., FIGS. 80 and 81), the product configurations of FIGS. 79-90 can be achieved.

Referring to FIG. 79, a plan view of a product variation showing slip/cut applied front ears 1144, alternately rotated back ears 1042, 1044, and extension panels 1012 extending from the back ears 1042, 1044 is shown.

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Referring to FIG. 80, the embodiment of FIG. 79 is shown, with the additional product feature of leg portions **1200a** and **1200b** of the chassis removed from the chassis, to fit around the leg of a wearer.

Referring to FIG. 81, the embodiment of FIG. 80 is shown, with the additional product feature of chips **1230** having been removed from both the front ear and back ear portions of the product, for instance using the severing and chip removal pattern of FIG. 76.

Referring to FIG. 82, a plan view of a product variation showing alternately rotated front and back ears using the techniques described above (e.g., using the technique to construct the embodiments shown in FIG. 28 and/or FIG. 60 above) is shown.

Referring to FIG. 83, the embodiment of FIG. 82 is shown, with the additional product feature of leg portions **1200a** and **1200b** of the chassis removed from the chassis, to fit around the leg of a wearer.

Referring to FIG. 84, the embodiment of FIG. 83 is shown with the additional product feature of chips **1230** having been removed from both the front ear and back ear portions of the product, for instance using the severing and chip removal pattern of FIG. 76.

Referring to FIG. 85 a plan view of a product variation showing slip/cut applied front ears **1144**, and alternately rotated back ears is shown.

Referring to FIG. 86, the embodiment of FIG. 85 is shown, with the additional product feature of leg portions **1200a** and **1200b** of the chassis removed from the chassis, to fit around the leg of a wearer.

Referring to FIG. 87, the embodiment of FIG. 86 is shown with the additional product feature of chips **1230** having been removed from both the front ear and back ear portions of the product, for instance using the severing and chip removal pattern of FIG. 76. Referring to FIG. 88, a plan view of a product variation showing alternately rotated applied front ears, and alternately rotated back ears, using the previously described techniques, for instance the technique used to construct the product configuration shown in FIG. 28 is shown, with the exception that no extension panel is present in the embodiment shown in FIG. 88.

Referring to FIG. 89, the embodiment of FIG. 88 is shown, with the additional product feature of leg portions **1200a** and **1200b** of the chassis removed from the chassis, to fit around the leg of a wearer.

Referring to FIG. 90, the embodiment of FIG. 89 is shown with the additional product feature of chips **1230** having been removed from both the front ear and back ear portions of the product, for instance using the severing and chip removal pattern of FIG. 76.

Referring to FIG. 91 a schematic plan view of an extension panel nonwoven web **801/802** is shown, receiving tapes **805**, which are then folded down over the extension panel nonwoven web **801/802**. A stretch laminate web **810a/810b** is provided, which receives slit and spread extension panels **801/802** of the extension panel nonwoven, and the combination stretch laminate web **810a/810b** coupled with the extension panels **801/802** holding folded ears **805**, is itself slit and spread.

Referring now to FIG. 92, side panel nonwoven web is provided with chip portions **911** for later removal. As shown in FIG. 93, the side panel nonwoven web **910A/910B** receives (preferably by slip/cut techniques) discrete pieces of the combination stretch laminate web **810a/810b** coupled with the extension panels **801/802** holding folded ears **805**. The combination stretch laminate web **810a/810b** coupled with the extension panels **801/802** holding folded ears **805**

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is then folded over, as shown in FIG. 94, slit and spread as shown in FIG. 95. Next, chips **911** are removed as shown in FIG. 96. Next, discrete combination stretch laminate web **810a/810b** coupled with the extension panels **801/802** holding folded ears **805** carried by the nonwoven web **910A/910B** portions are then severed, and joined with a chassis web as shown in FIG. 98. Next, a die cut unit is used to sever discrete diapers as shown in FIG. 99 which shows a plan view of a finished diaper in a laid open position. The severing takes place between desired portions of the combination stretch laminate web **810a/810b** coupled with the extension panels **801/802** holding folded ears **805**, carried by carried by the nonwoven web **910A/910B** to form a discrete product.

Referring now to FIG. 100, an alternate chip pattern **911'** is shown, for use in the construction of FIGS. 91-99. This shape allows for greater flexibility in the positioning of the sever to form discrete diapers.

Referring now to FIG. 101, an apparatus for placing ears **12** on a chassis web **10**, with zero waste, from a single incoming lane **16** is shown. This embodiment is useful if it is desired to avoid rotation of the ears as previously described, about two different rotational axes.

The apparatus provides for synchronized anvil/die combination **1110** to sever the incoming web **16** into desired preferably symmetrical ear shapes **12**, such as those shown in FIGS. 7A-7E, or shown in FIG. 104. A canted right and a canted left ear rotational and spreading assembly **1120R** and **1120L** acquires individually cut ears **12** (for instance, by slip/cut techniques), which are carried for instance on pucks **1126R** and **1126L**, for instance of the vacuum assisted variety shown as pucks **234** on FIGS. 10a and 10B. The canted spreading assemblies provide for cross machine direction displacement of ears **12** so that ears can be simultaneously spread and accelerated to be placed as desired, with ear **12** rotation about only a single axis, the axis rotating canted right and the axis rotating a canted left ear rotational and spreading assembly **1120R** and **1120L**, but canted pucks, relative to the axis of rotation, allows correct orientation when picking up and depositing ears **12**.

In a preferred embodiment of this apparatus, there is no axial rotation of ears **12** so that the shape of the ear **12** can be provided for symmetrical with respect to right and left ears, with zero incoming web wasted.

The rotational and spreading assemblies **1120R** and **1120L** are preferably provided with vacuum in order to maintain the ears **12** during rotation and then release the ears onto secondary right rotational assembly **1122R** and secondary left rotational assembly **1122L** which further spread the ears **12**, and further speed up the ears **12** to a depositional velocity of the chassis web **10**. Preferably, the secondary right rotational assembly **1122R** and secondary left rotational assembly **1122L** also rotate ears **12** about a rotational axis, but it is not required to rotate the ears about the axis of the ears. The secondary right rotational assembly **1122R** and secondary left rotational assembly **1122L** are also preferably vacuum assisted to control ears **12**, and likewise contain pucks **1128R** and **1128L**, again similar to the pucks **234** of FIGS. 10a and 10B.

The right rotational assembly **1120R** will spread the right ears and speed up the right ears from the incoming velocity to a depositional velocity of the chassis web **10**. The left rotational assembly **1120L** will spread the left ears and speed up the left ears from the incoming velocity to a depositional velocity of the chassis web **10**. It is noted that the left or right ears could be provided in a line vertically spaced from its

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intended deposition point, and then just one of the other of the left or right ears would require cross-machine direction displacement for deposition.

As can be seen from the side perspective view of FIGS. 102 and 103, the embodiment shown in FIG. 101; the pucks 1126L and 1126L are nested such that they pick up ears 12 coming in sequence. Also preferably, the pucks are canted at an angle relative to their rotation, such that the pick up points and deposition points of the ears 12 are relatively horizontal relative to the machine direction. The pucks 1126L and 1126L match up with rotating pucks 1128R and 1128L respectively, to deposit the ears prior to deposition on chassis web 10.

A small mismatch in speeds is preferred between the pucks 1128R and 1128L respectively is preferable to get the product pickup and placement to match.

Referring now to FIG. 105 a schematic of a process of forming and combining extension panels and ears using a dual cut slip unit is shown. An extension panel is formed and passes to a die unit and is optionally folded, slit and spread. The running extension panel web passes to a slip cut unit, is severed by a first knife which cuts the web at a selected speed, such as correlating to two times per product pitch. The anvil, because the unit is preferably a slip cut unit, has the effect of speeding up the web after the web is cut by the first knife.

A second knife then cuts the web a second time, preferably at pitch. This arrangement creates a first gap between pieces having been slip cut, and the pieces having been slip cut are severed in half (preferably) by the second knife cut. The first gap is set when the web speeds up on the knife anvil after the cut by the first knife.

When the severed web portions are transferred from the dual cut slip unit to a dual intermittent ultrasonic bonding anvil roll, incoming ear webs are fed into the system, which are alternately bonded to a first and second incoming ear web, then both lanes are folded, tack bonded and passed to the nested zero waste back ear applicator device, such as that shown in FIG. 8a.

Referring now to FIG. 106, a side process view of one side of an apparatus and method of forming and combining extension panels and ears using a dual cut slip unit 2100 is shown. An extension panel web 2102 is fed to a dual slip cut unit with rotating anvil 2106 and rotating knives 2104. As shown in FIG. 105, the extension panel web 2102 has been previously slit and spread into two, a left side and a right side extension panel web, to create two lanes (see FIG. 112). The same operations will occur to the left and right lanes as described below with respect to web 2102.

A first gap is formed, as shown on FIG. 107, between successive severed pieces 2102' after passing the first knife 2104. Referring now to FIG. 108, severed pieces 2102' are carried by the dual slip cut unit and anvil 2106 by means such as vacuum, to a second knife unit 2104 which subdivides the severed pieces 2102' into subdivided pieces 2102". The subdivided pieces 2102" are past to a transfer roll 2108, which creates a second gap between subdivided pieces and also causes a small increase in the first gap, which occurs to the web when they speed up at the transfer roll 2108 described later.

Referring now to FIG. 110, following the cut on the severed pieces 2102', the subdivided pieces 2102" remain carried by the anvil roll 2106 with the first gap and the second cut. Every other of the subdivided pieces are coupled to incoming web 2110a and obtained by roll 2112 and, while

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remaining pieces are coupled to incoming web 2110b by tack bonder 2112 and passed to transfer roll 2118 (refer to FIG. 112).

Referring now to FIG. 110, the subdivided pieces 2102" are passed to a transfer roll 2108, rotating faster than the anvil roll 2106. Vacuum is turned off the anvil roll 2106 underneath and roughly simultaneously with the approach of a subdivided piece to transfer roll 2108, which allows a leading subdivided piece 2102" to advance in front of a trailing subdivided piece 2102" of a severed piece 2102'. FIG. 111 displays both the first gap between two severed portions 2102', which has been enlarged, and the second gap, between the leading subdivided piece 2102" in front of the trailing subdivided piece 2102". The second gap is set when the materials are passed to a faster moving transfer roll 2108, which both increases the first gap and creates the second gap.

Referring to FIG. 110 and FIG. 112, a first incoming ear web 2110a is provided to the transfer roll, to bond with the severed pieces 2102"a of FIG. 112, using the first ultrasonic bonding unit 2120. This web is removed from the transfer drum 2108 and passed to transfer roll 2112, folding unit 2114, and tack bonder 2116, and next severed such as shown in FIG. 31, and then passed downstream to the nested zero waste back ear applicator device, such as that shown in FIG. 8a. The drive side ultrasonic bonder in the first set will bond the extension panel onto the ear. Every other extension panel is bonded to the ear. The same application will occur on operator side ultrasonic bonding unit in the first set, in the sequence shown on FIG. 112.

Product pitch is a length of a leading edge of one edge of first product to the leading edge of an adjacent second product in a continuous manufacturing process (or a distance between trailing edges of adjacent products). Product pitch is related to machine speed. For a product of certain length, for instance 500 mm, if the machine speed is 500 meters per minute, then the machine is producing 1000 products per minute.

The severed pieces 2102"b of FIG. 112 are not bonded by the first ultrasonic bonding unit, but instead are still carried by the transfer drum 2108 to be coupled with a second incoming ear web 2110b, and then bonded to that web as shown in FIG. 112 using the second ultrasonic bonding unit 2122. This web is removed from the transfer drum 2108 and passed to transfer roll 2118, folding unit 2114, and tack bonder 2116, and next severed such as shown in FIG. 31, and passed downstream to the nested zero waste back ear applicator device, such as that shown in FIG. 8a. The second web enters the second set of ultrasonic bonding units and bonds the extension panels that were not picked up from the first set of ultrasonic bonding units. The drive and operator side ultrasonic bonding units will intermittently bond the extension panel to the second incoming ear web, as also shown on FIG. 112.

Still referring to FIG. 112, the sequence can be followed. In the first step of the sequence, after the second knife cut on dual slip cut unit 2108, the spacing is set on transfer to unit 2108. In the next step of the sequence, subdivided portions 2102a" are picked up at the first bonder 2120 and coupled to web 2110a. Subdivided portions 2102b" are picked up at the second bonder 2122 and coupled to a web 2110b. In the next step of the sequence the dual webs are spread and folded over on exit, and passed downstream.

Alternatively, two running webs of extension panels and ear webs could be formed, and folded over (not shown). The

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extension panel can have die cut, c-fold and tack bonding operations performed before entering the dual cut-slip unit 2100.

The foregoing is considered as illustrative only of the principles of the invention. Furthermore, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described. While the preferred embodiment has been described, the details may be changed without departing from the invention, which is defined by the claims.

We claim:

1. A method of severing and spacing a first web of material comprising:

providing a first web of material at a first speed;

severing said first web to create a first and a second portion of said first web;

providing said first and second portions of said first web to an accelerating unit;

creating a first gap space between said first and second portions of said first web;

severing said first and second portions of said first web to create a first and a second subdivision of said first portion of said first web; and a first and a second subdivision of said second portion of said first web;

providing said first and second subdivisions of said first portion of said first web and said first and second subdivisions of said second portion of said first web to an accelerating unit to create a second gap space in a machine direction between said first and second subdivisions of said first portion of said first web and a second gap space between said first and second subdivisions of said second portion of said first web; and

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coupling said first and second subdivisions of said first portion of said first web and said first and second subdivisions of said second portion to a carrier web, said method further comprising providing a left lane and a right lane of aid first web of material,

said method further comprising coupling said second subdivision of said first portion of said left lane of said first web, and said first subdivision of said first portion of said right lane of said first web to a first carrier web; and coupling said first subdivision of said first portion of said left lane of said first web, and said second subdivision of said first portion of said right lane of said first web to a second carrier web.

2. A method according to claim 1, said method further comprising coupling said second subdivision of said second portion of said left lane of said first web, and said first subdivision of said second portion of said right lane of said first web to said first carrier web; and coupling said first subdivision of said second portion of said left lane of said first web, and said second subdivision of said second portion of said right lane of said first web to said second carrier web.

3. A method according to claim 2, said coupling step comprising ultrasonic bonding.

4. A method according to claim 1, the method further comprising passing said first and second webs carrying said portions of said first and second webs to an apparatus for severing said first and second webs and reorienting selected severed portions of said first and second webs.

5. A method according to claim 4, the method further comprising tack bonding said subdivisions to said carrier webs.

6. A method according to claim 1, the method further comprising folding said subdivisions over said carrier webs.

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